MACHINERY

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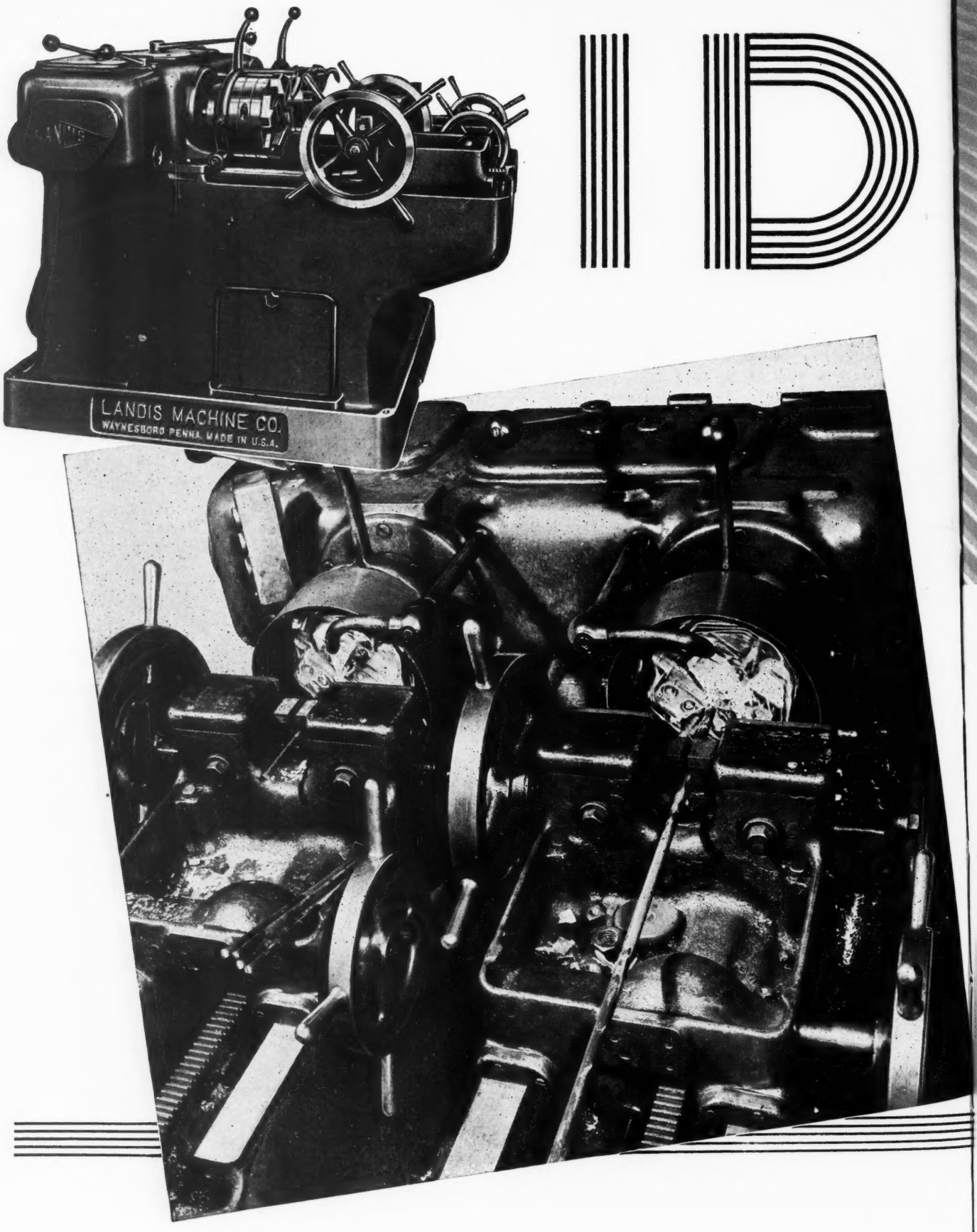

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MACHINERY
Vol. 56 AUGUST, 1950 No. 12

Recording Surface Finish and Wear of Gear Teeth

By J. W. SAWYER and J. G. McCUBBIN
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THE need for a means of recording and analyzing surface roughness and wear has led the engineer to develop a number of methods and devices to meet this requirement. A comparison of various methods employed for studying roughness and progressive wear of gear teeth will be given in this article, and their relative merits and limitations will be discussed in order to aid those concerned with the wear of gear teeth in selecting the particular method best suited for the problem in hand. These methods can be applied, with little or no modification, to other machine elements as well.

Those interested in gear tooth wear include the designer, the manufacturer, and the user. The designer and manufacturer are anxious to learn of tooth wear patterns and how they change during operation. The study of wear of tooth surfaces in test periods can be utilized by the designer in modifying tooth forms, surface roughness, lubrication, materials, and other factors that have a direct bearing on the successful operation of a gear. Adequate knowledge of variation in tooth surface finish is essential to enable the manufacturer to produce units that will perform satisfactorily. The user of the gear has a keen interest in the progress of tooth wear. Records of surface markings will help the user to take the proper measures to prevent future failures.

The wear of gear teeth has been defined by E. Buckingham as "anything that alters the form, size, or surface smoothness of the gear tooth profiles." The principal kinds of gear tooth wear may be classified as follows:

Pitting—There are several forms of pitting. Initial or corrective pitting appears as pits of pin-head size or smaller, usually starting near the pitch line. This kind of pitting may be noted in the early life of a gear and may cease after progressing to a degree that does not impair the life of the unit. Progressive pitting occurs when pits continue to form at an increasing rate in both number and size. Severe progressive pitting, as illustrated in Fig. 1, will usually result in the destruction of a gear.

Abrasion—Working surfaces of gear teeth may be damaged by the entrance of small particles of metal or grit between mating teeth. Abrasion is indicated by fine scratches, appear-

ing at random, that may extend from the root to the tip in the direction of sliding on an otherwise smooth tooth flank.

Scoring or Cutting—Wear of this type occurs when rough surfaces or sharp corners are present at such positions as to break through the film of lubricating oil. Scoring or cutting is similar to abrasion, although the latter type of damage usually has an irregular pattern.

Spalling—This resembles destructive pitting, and is characterized by the shearing out of flakes of material near the pitch line.

Galling or Scuffing—Plastic flow may result from momentary failures of lubrication, during which time high surface temperatures may be encountered and particles of metal will actually be pulled from the tooth surface. The plastic flow is toward the pitch line on the driven gear and away from the pitch line on the driving gear. As a result, a ridge is formed on the pitch line of the driven gear and a groove on the pitch line of the driving gear.

Seizing—Failure of lubrication, extreme loading, or both of these conditions may result in temperatures that are sufficiently high to permit particles of metal on one tooth to be welded to the contacting surface of the mating tooth. Fig. 2 shows a gear that has failed in this manner.

The evaluation of surface roughness or finish and the determination of wear rates are comparatively simple in the case of small parts that can be handled and weighed with ease. However, the measuring of surface roughness and wear in heavy machine elements, such as the main propulsion gears of a large ship, is not a simple problem.

Certain of the devices and methods developed to examine the surfaces of gear teeth and other machine parts lend themselves for use only on surfaces that are easily accessible. Others require exacting equipment and methods. Accuracy limitations preclude the use of some procedures and equipment. It is necessary for the user to select a method that will give the essential information with a minimum expenditure of time and effort. For example, a manufacturer producing a machine part with a maximum surface roughness of 50 micro-inches r.m.s. may not find it economical to utilize exacting methods and precision equipment capable of measuring surface roughness of 2 micro-inches r.m.s.

Both qualitative and quantitative measurements of surface roughness are valuable. The finish of surface may be inspected qualitatively by visual, optical, or touch comparison with standards or it may be quantitatively determined by measuring a parameter related to roughness.

Inspecting Finish by Comparison with Standards

The simplest method used to evaluate surface roughness is by comparison with a set of standards, such as that shown in Fig. 3. Such sets are available from different manufacturers. They usually consist of representative types of surfaces on small metal plates. The type of surface and its micro-inch finish are indicated on a chart or on the plate. With this method, the surface finish of a part is determined by simple visual or touch comparison, and is taken to be that of the standard surface with which it is matched.

The accuracy of this method may be increased by using the comparison microscope, which permits the work surface to be inspected and compared with a standard piece in a single field of view under identical conditions of illumination.

The most widely used precision instruments for quantitative measurement of surface rough-

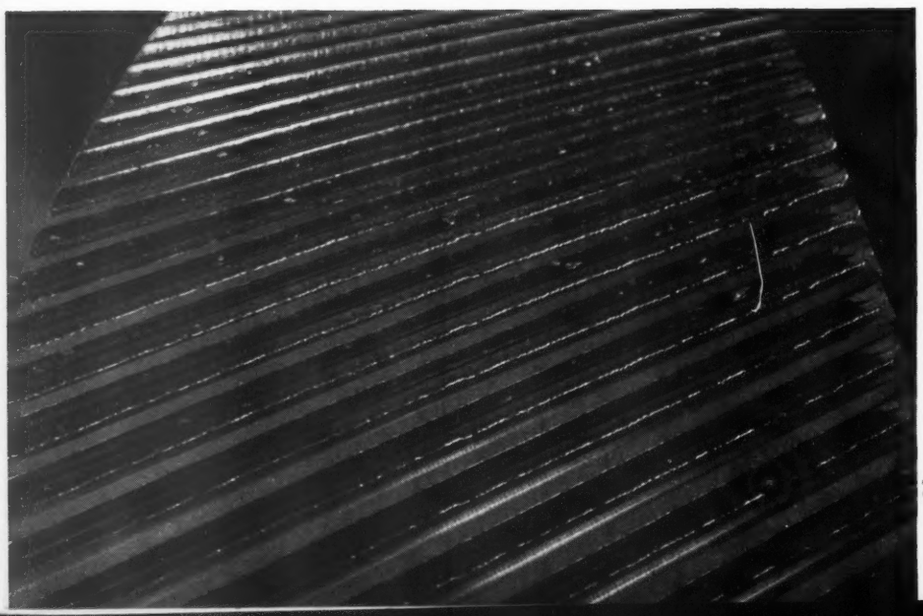

Fig. 1. This badly pitted marine gear is an example of severe progressive pitting. In such cases, pits continue to form until gear fails

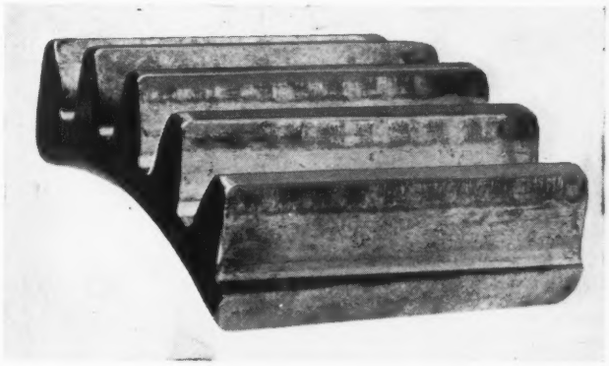

Fig. 2. Sector of a gear that has failed due to seizing of engaging gear teeth. Such condition can be caused by failure of lubrication, extreme loading, or both

ness are the popular stylus units, such as the Profilometer, the Brush analyzer, and the "Proficorder." In these instruments, a stylus follows the minute peaks and valleys on the surface. Movements of the stylus are amplified by a suitable electric circuit and indicated on a meter graduated in micro-inches or traced on a chart with micro-inch coordinates. There are two types of profile charters—one that traces the actual profile on the chart, and another that traces a root mean square curve. The scale is magnified on both types of charts. A Profilometer chart of a surface comparator plate is shown in Fig. 4.

With the so-called "replica" methods, an impression or casting is made of the surface, using a suitable material, and the negative impression so obtained may be examined either visually or by optical means, or it may be measured with a stylus instrument.

These methods are well suited for determining the roughness, wear, and damage to the surfaces of marine reduction gear teeth. Main propulsion gears are too large and unwieldy to bring into the laboratory for checking with stylus type instruments. Furthermore, the tooth surfaces are inaccessible to many types of instruments. The replica process permits impressions or castings to be made on shipboard by inexperienced personnel, and then forwarded to a laboratory, where the finish can be measured on the replica by instruments. These replicas may be utilized by qualified personnel in making diagnoses of unusual cases of tooth wear.

At the present time, negative replicas are being taken of reduction gear teeth under test, and are being used to study progressive wear and failure. The replicas have a particular advantage in that they provide permanent records. Replicas may be placed in two general classifications—namely, pliable films and rigid castings.

Pliable Film Method of Producing a Record of the Surface of Gear Teeth

Pliable films have offered an inexpensive means of producing a permanent record of surface characteristics. Some of these films may be used in conjunction with other equipment to evaluate surface roughness quantitatively. The following pliable film methods are suited for the inspection of gear teeth:

Faxfilm—The pliable film known by the trade name "Faxfilm," is used primarily to obtain a qualitative picture of surface finish in a form that can be retained as a permanent record. A strip of transparent plastic film about 1 inch wide is cut from a roll and brushed on one side with a solvent. The moistened side is immediately pressed down on the surface to be exam-

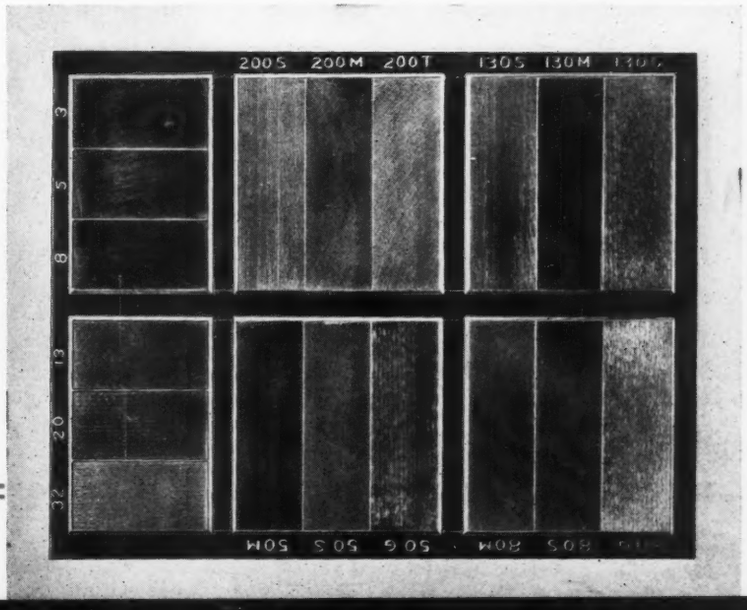

Fig. 3. A simple method of evaluating surface roughness is by comparing the surface with a set of standards on a comparator block

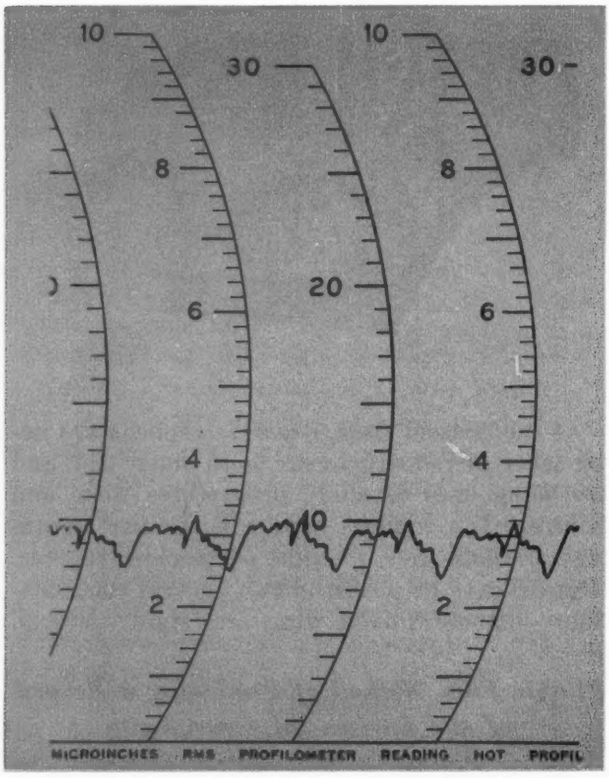

Fig. 4. Profilometer chart obtained when stylus was traversed over the surface of a master on the surface roughness comparator block seen in Fig. 3

ined and left in place about 1 minute. At the end of this time, the film may be peeled from the surface and mounted in a card holder for projection purposes.

The side that was moistened with solvent will be a negative reproduction of the surface being inspected, and the film will vary in thickness according to the roughness of the surface. When this film is projected on a screen as an enlarged image, areas where depressions existed on the original specimen will be thicker on the film and will transmit less light. Thus the depressions on the specimen under study will show as shadows on the projected image. The image projected by transmitted light provides an enlarged relief map of surface roughness for qualitative examination. The slides made from these films may be marked for identification and retained as permanent records.

Herschman's Method—H. K. Herschman, of the National Bureau of Standards, has developed a novel method of evaluating surface finish quantitatively from pliable films. The film used is a transparent ethyl cellulose plastic 0.005 inch thick. A solvent of 80 per cent toluene and 20 per cent acetone is applied to the metal surface to be inspected and a small strip of film, 1 1/2 inches wide, is pressed down on the wet area. One minute is usually sufficient time for the solvent to evaporate; then the strip is carefully peeled off the surface.

The apparatus required to obtain a quantitative evaluation of surface roughness from the plastic impression consists of a frame for mounting the film, a source of light, an electric circuit including a 90-volt battery, a photo-electric cell, and an alternating-current voltmeter (Fig. 5). The frame in which the film is mounted is located so that a beam of light is directed from the source through the plane of the film to the photo-electric cell. The frame is oscillated in such a manner that the film continues to remain normal to the light beam.

Because of the variations in thickness of the film, the intensity of the light beam striking the photo-electric cell will vary as the film is oscillated. These variations in the intensity of light actuate the electric circuit, so that a fluctuating current flows through the 5 megohm resistance. The small potential difference, across the resistance, which ultimately depends on electron emission in the photo-electric cell, is indicated by the

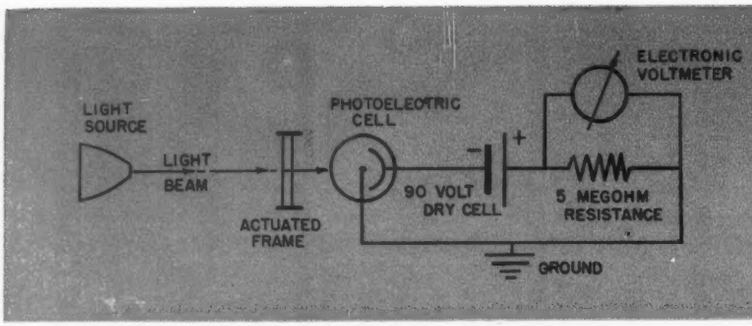

Fig. 5. Diagrammatic arrangement of the apparatus developed by H. K. Herschman at the National Bureau of Standards for evaluating surface finish from pliable films

electronic voltmeter. An impression from a rough surface will cause much more variation in the intensity of light than an impression from a smooth surface. Therefore, the voltmeter reading is indicative of the roughness of a surface. The voltmeter may be calibrated with impressions from standard surfaces of known finish.

National Physical Laboratory Method—A pliable film technique in which the impressions are used to measure surface finish quantitatively with the aid of a stylus recording instrument has been developed by the National Physical Laboratory in England. This method employs a cellulose acetate sheet, 1/8 inch thick, which is cut into strips of 1 by 1 1/2 inches. A few drops of acetone are applied to one side of these pieces. As before, the wet side is pressed firmly into contact with the metal surface to be examined. The solvent evaporates in a few minutes, after which the pieces may be removed and mounted, impression side up, on a rigid surface. The micro-inch finish can then be measured directly on the impression with a stylus instrument.

These impressions have been used for measuring the finish of large machine components where it is not feasible to transport the instrument from the laboratory. They can also be used to measure finish on inaccessible areas, such as the roots of marine gear teeth and the flanks of master lead-screws, which are not readily accessible to the probes of ordinary stylus instruments.

Dye-in-Solution—A simple method for examining and recording the roughness and porosity of a surface makes use of a plastic solution colored with a dye. The solution is prepared by dissolving polyvinylformal (Formvar) in ethylene dichloride. Ethyl violet is added to color the solution. The surface to be examined is painted with this colored solution. After the solvent has evaporated, the thin negative impression is removed by means of gummed transparent acetate tape. When the resulting strip is placed against an illuminated or white background, the depressions which were in the surface of the original specimen will appear darker colored in the replica. A microscope may be used if sufficient detail is not apparent from a visual inspection.

The preparation of materials for taking a pliable film impression by the methods described is relatively simple. As indicated in Table 1, heating or pressurizing equipment is not required for any of these methods, and weighing and measuring are necessary only in Herschman's method. Inspection of impressions by image projection is advisable for the Faxfilm, Herschman's, and Dye-in-Solution methods. The National Physical Laboratory method is the only pliable film technique suited for measurement with a stylus instrument. Rough areas with deep pits and sharp edges cannot be recorded with the pliable films. Also, these methods are not suitable for recording contours, such as tooth profiles.

Table 1. Comparative Features of Various Methods of Recording Surface Characteristics

Method	Weighing or Measuring of Materials Required	Heating Required	Measure with Stylus Instruments	Time Required, Minutes
Faxfilm	No	No	No	3
Herschman's Method	Yes	No	No	5
National Physical Laboratory Method	No	No	Yes	5
Dye-in-Solution	No	No	No	8
Paraffin Wax	No	Yes	No	20
Plaster	No	Yes	No	400
Sulphur-Graphite	Yes	Yes	No	50
Thermosetting Plastic	No	No	Yes	50

Records of inaccessible areas, such as the roots of small gear teeth, are not easily produced with pliable films. The time required to produce a pliable film record adaptable for study by any one of several means is estimated to vary from three to eight minutes. This is based on the assumption that equipment and materials are available and ready for immediate use.

Rigid Casting Methods of Producing Replicas of Gear Teeth

With the rigid casting methods of producing replicas, a three-dimensional impression, which reproduces the shape, contour, and finish of the surface under study, is produced. Such replicas of gear teeth are particularly valuable in that they show the relative locations of damaged and excessively worn areas. Castings may be obtained of small teeth to record the surface characteristics of the roots and flanks that are inaccessible with pliable films and other methods. Not all casting materials are well suited for this

purpose. The principal materials and processes applicable for gear tooth inspection by rigid casting methods are as follows:

Paraffin Wax—Paraffin wax melts readily and flows at low temperatures, but it also shrinks upon hardening and is relatively soft and easily deformed at room temperatures. Its use for recording surfaces has probably come about because of its low cost, availability, and ease in handling. The negative replica castings produced have the appearance of gear teeth, but the impression of the roots of the teeth are on the top and the relative positions of the addendum and dedendum are reversed.

Plaster—Castings of plaster have been used to keep a complete record of gear tooth wear on turbine-driven ships. In order to use this method, a negative casting must first be made from paraffin wax. This is done by building a dam of putty around the teeth to be inspected and then pouring melted wax into the resulting mold. The solidified wax forms a negative casting, which must be removed and used as a component of a similarly constructed mold for the plaster casting. When the second mold has been prepared, by constructing a putty dam around the wax impression, it is compactly filled with a thick plaster mix. After the plaster has hardened, the wax may be melted away or pried off, leaving a plaster duplicate of the gear teeth.

Both the wax and plaster shrink when they harden. However, the shrinking of the wax provides a slightly over-size mold for the plaster, and since the plaster also shrinks upon hardening, shrinkage errors tend to cancel each other. A refined Portland cement has been found most suitable for this purpose; it should be well mixed to exclude air bubbles which may mar the casting. It requires approximately six hours for the plaster to set.

The thickness of a gear tooth at the pitch line or any arbitrary depth may be measured on the casting with vernier calipers. Castings may be made periodically and measured to plot the wear of teeth in service. These castings, properly labeled, serve as a permanent record.

Sulphur-Graphite—Castings of sulphur and graphite have long been used for recording surface roughness and damage. Various proportions may be employed, but a combination of 12 per cent of graphite and 88 per cent of sulphur, by weight, has given good reproductions of surface conditions.

This material is relatively simple to apply. The graphite and sulphur are mixed in the proper proportions, and then heated until the mixture is molten. It is then immediately poured onto the surface under study. The casting cools rapidly in contact with metal surfaces, after which it may be removed for examination.

Thermosetting Plastic—The production of a negative replica of a gear tooth is readily accomplished by the use of a thermosetting, free-flowing polyester resin. This resin hardens in about twenty minutes after the addition of a catalyst. The attractive features of this method are the ease with which the material is handled and the accuracy of the replica. The resin and catalyst are obtained in preweighed quantities, and do not require pressure or external heat to harden. This resin was recently developed for the Bureau of Ships, Department of the Navy, to be used in recording wear of gear tooth surfaces under test and operating conditions.

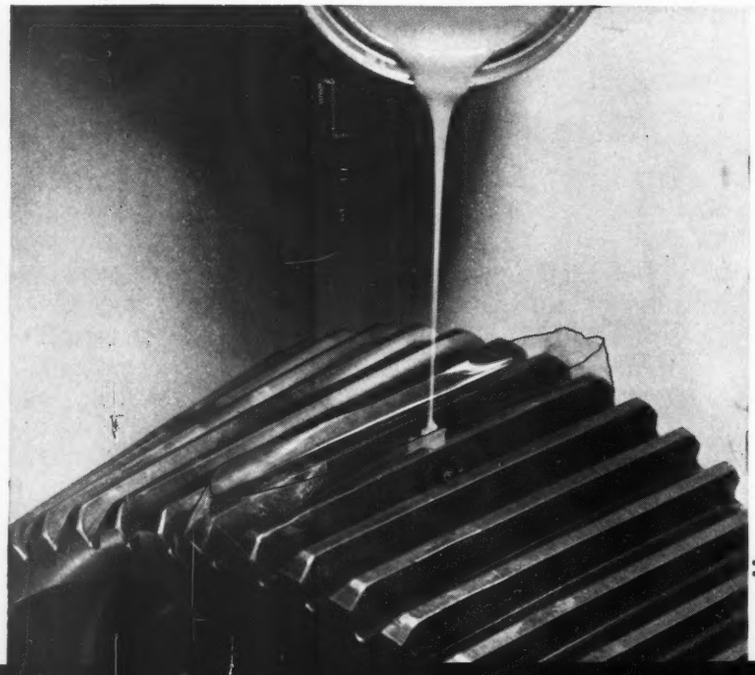

Fig. 6. Negative replicas of gear teeth can be produced by pouring a thermosetting resin around the teeth. Cellulose-acetate tape confines the resin to the desired areas

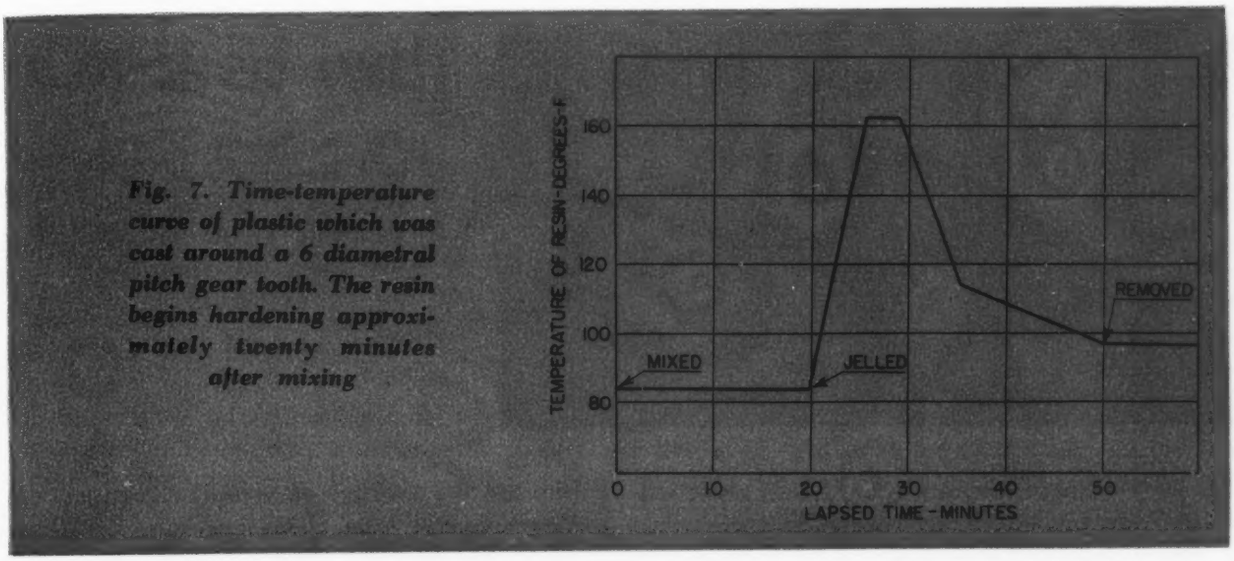

Fig. 7. Time-temperature curve of plastic which was cast around a 6 diametral pitch gear tooth. The resin begins hardening approximately twenty minutes after mixing

The steps for producing the replica of a gear tooth area are quite simple. It is extremely important that the metal surface be thoroughly cleaned to remove foreign materials, such as oil, grease, water, or other matter that would produce inaccurate surface replicas or cause the casting to stick to the tooth. The following procedure has been developed for making surface replicas, in the negative, by the use of the polyester resin:

1. Clean all metal surfaces that will come in contact with the resin. Acetone has proved adequate for this purpose. However, care should be exercised in using toxic or inflammable solvents.

2. Select areas and construct retainer walls to restrict the resin and prevent the castings from locking in place. Cellulose-acetate tape has been used for this purpose with excellent results. The retainer walls should extend at least 1/2 inch above the top of the tooth. This permits the resin to be poured to a height of 1/4 inch above the top of the tooth.

3. Mix the resin and catalyst. Stir the resin to disperse the filler evenly, as it has a tendency to settle. Work the plastic tube containing the catalyst by hand until the liquid and paste are well mixed. Then cut the end of the tube and squeeze the catalyst into the resin, mixing with a stirring rod, using slow, even strokes. If the contents are mixed too rapidly, air may be trapped in the resin and cause surface imperfections.

4. Pour the resin. The resin catalyst mixture is poured into the area surrounded by the retainer and readily flows into all sections. The manner of pouring the resin into a tooth area is shown in Fig. 6. The resin will begin to harden in about twenty minutes after the addition of the catalyst. This reaction is exothermic. A time-temperature curve of resin cast into a 6 diametral pitch gear tooth is shown in Fig. 7. The retaining tape may be removed after the resin has hardened. The casting should be left in place for approximately thirty minutes after jelling in order to permit the material to take a firm set.

5. Remove the casting. This may be facilitated by running a knife under each edge of the impression along the top of the teeth. A slight

Table 2. Profilometer Measurements in Micro-Inches r.m.s. of Comparator Blocks and Plastic Impressions

Comparator Block	Plastic Impression	Deviation
2.9	2.9	0
6.3	5.4	— 0.9
7.5	7.5	0
12.7	12.1	— 0.6
17.4	17.1	— 0.3
33.0	29.0	— 4.0
36.5	38.2	+ 1.7
70.3	72.2	+ 1.9

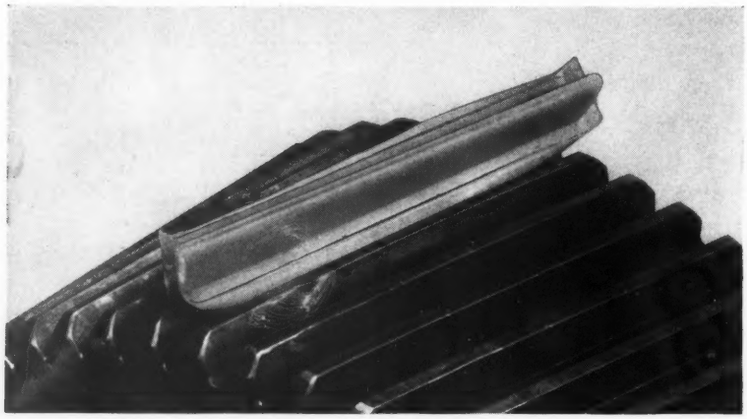

Fig. 8. Negative replica of a damaged gear tooth obtained by pouring thermosetting plastic around the tooth, as illustrated in Fig. 6

pry on one end of the casting is usually sufficient to part the resin and tooth material.

The negative replica may be handled immediately after removal. It is advisable to let the casting age for twenty-four hours before exploring the surface with a stylus, as in the Profilometer. A plastic replica of the damaged tooth is shown in Fig. 8.

The methods employed to produce rigid castings, as described, are relatively simple. Heating is necessary for the wax and sulphur-graphite methods. Thermosetting plastic, however, can be cast without the application of external heat. Also, the weighing of proper proportions of sulphur and graphite is required with the sulphur-graphite method.

Inspection with stylus instruments is practical on castings of thermosetting plastic. Results of Profilometer measurements on a surface roughness comparator block of the type illustrated in Fig. 3 and measurements on a casting of this block are given in Table 2. The values shown are the average of several recordings on the Profilometer tape. The maximum deviation in micro-inches r.m.s. was 0.9 in the range 2.9 to 17.4, and 4.0 in the range 33.0 to 70.3.

Profilometer measurements of a sulphur-graphite impression and a metal plate indicated a wide deviation between the finish of the replica and the plate. Castings are capable of recording rough areas that are cut with deep pits and sharp edges. The polyester resin is considered superior to sulphur-graphite, plaster, and wax due to its greater rigidity.

General contours, such as tooth profiles and fractures, can be recorded with any of the rigid casting methods. Fig. 9 shows a plastic casting of a fractured gear tooth, with the fractured area indicated by an arrow. Inaccessible areas, such as the roots of small gear teeth, are easily reached by these casting materials. The time required to produce a rigid casting record will vary over a wide range. Replicas of thermosetting plastic may be produced in approximately fifty minutes. Wax impressions are estimated at twenty minutes. Plaster records may require 400 minutes to complete.

The pliable films and rigid casting methods that have been described are considered satisfactory for recording surface finish and wear on gear teeth. There are features that make certain methods more attractive for a particular application. The user must select the procedure to give the desired results under requirements set forth by the type area to be studied and the equipment available.

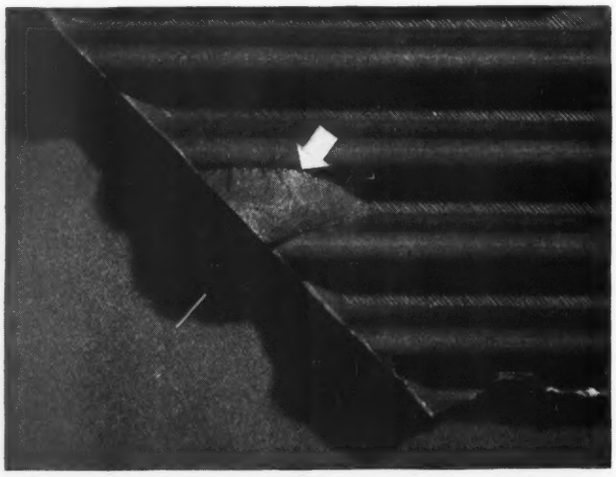

Fig. 9. Plastic casting of a fractured gear tooth. The fractured area of the tooth is indicated by an arrow

Turbine-Blade Contours Rapidly Checked with Air Gage

THE complete contour of jet-engine turbine blades can be inspected on a production basis by means of an eighteen-column Precisionaire fixture developed by the Sheffield Corporation of Dayton, Ohio. Each blade can be inspected in a few seconds, just as rapidly as the blade can be loaded into and unloaded from the gaging position.

Expensive minimum or maximum master gages are not required for setting the blade contour measuring fixture. Instead, a selected, carefully calibrated turbine blade is used as a "mean" master. Gage-blocks are employed to locate the gaging head mounting plates for upper, middle, and lower calibrated points of inspection. The gaging heads are then clamped in the proper position and feeler gages are used to set up the base instrument—not for the calibrated blade, but for a theoretical perfect blade. Positions of the floats will then indicate how much the blade being checked varies from the theoretical perfect blade.

The eighteen gaging contact points are placed in contact with the blade, a set of three for the internal (concave) side, and a similar set of three for the external (convex) side, at the top, middle, and bottom of the blade. The positions of the eighteen floats form a graph of the measurement of the blade, which can be read at a glance, as seen in the accompanying illustration. If desired, the thickness at any point can be checked by comparing the float position in an external tube with the float position in the corresponding internal tube.

Tolerances maintained on the blade contour are ± 0.0025 inch on the internal points and ± 0.0075 inch on the external points. However, closer tolerances could be checked on this fixture or the tolerances could be increased if desired, since the columns for external and internal measurement have a total range, respectively, of ± 0.020 and 0.010 inch.

A feature of the fixture is its complete flexibility and adjustability to accommodate changes of design and a great variety of jet blades without modification. Blades can vary in width, height, or contour by more than an inch and still be accommodated by the gaging fixture. Interchangeable work-holders are required, however, if the root form dimensions change.

Adaptations of this fixture can be made for fewer, more, or different points of inspection, for locating the blade at different points, for blades of entirely different shapes, and for completely different types of parts where the same principle can be applied.

* * *

The sales of new motor vehicles reached an all-time monthly high of 696,893 in the month of May, according to the Automobile Manufacturers Association. This brought the sales for the first five months of the year to a total of 2,893,695—nearly 500,000 above the corresponding period for the peak year of 1949. Exports of motor vehicles during May totaled 24,454, compared with 19,259 in April. Total exports for the first five months were 101,787, compared with 140,185 for the same period last year.

An eighteen-column air gaging fixture for quickly inspecting the contour of jet-engine turbine blades on a production basis

Unusual Press Set-Ups Used in

By A. E. SWEET
Chief Tool Engineer
The Maytag Co.
Newton, Iowa

MANY unusual stampings are required to form the various parts of the new automatic washer built by the Maytag Co., Newton, Iowa, the leading producer of washing machines. The sheet-metal shop of the automatic washing machine plant is completely equipped for the high-speed production of these parts. It consists of a shearing department, a press room, a grinding room, and a welding department for making sheet-metal stampings and resistance-welded assemblies. More than 80,000 pounds of steel and aluminum are handled each day in this shop. Approximately 80 per cent of the stock used is cut to blank size from flat sheets by means of Niagara squaring shears and a Yoder slitting machine.

Two hundred operations are performed on seventy different parts for the automatic washing machine, which is being produced at the rate of 800 per day. These operations are performed on various types of Verson presses ranging in capacity from a 30-ton mechanical type to a 400-ton hydraulic press. The presses, some of which may be seen in the heading illustration, were selected and arranged to permit a high degree of flexibility in the production of various parts. By simply changing the dies, each line of presses can be quickly converted for producing a different part.

The drawing, flanging, and piercing of the intricate-shaped parts necessitates the use of high-tonnage presses and expensive dies. Smoothly formed, wrinkle-free stampings with close dimensional accuracy are essential to insure ease of assembly, pleasing appearance of the finished product, and efficient operation of the high-speed components.

All the blanks are lubricated prior to forming by means of the "Dri-Coat" process. They are first cleaned in an alkali cleaning tank, then rinsed in a hot water tank, and allowed to dry. Next they are dipped into a tank containing 10 ounces of a special dry soap (made by the Chandler Chemical Co.) per gallon of water for 1 1/2 minutes, removed, and dried by means of hot air. The blanks, coated with a film of lubricant from this treatment, are now ready to be drawn. It is not necessary to lubricate or recoat the parts for a subsequent flanging or second drawing operation. The soap solution in the dip tank is maintained at a temperature of about 190 degrees F.

It was originally contemplated to form the inner tubs, or spinners, for the automatic washer in one piece and then roll over the top in a spinning operation. After considerable experimentation, however, it was found to be more economical to produce this tub in two halves, and then seam-weld the circular halves together. An inner tub of two-piece design had never been manu-

factured, and many doubted that it could be successfully made on a mass-production basis.

Both upper and lower halves of the tub are now being formed from square blanks of 18-gage (0.0478 inch thick), deep-drawing Armco enameling iron. Blanks for the upper half are sheared into 29-inch squares from 8-foot lengths of flat stock, while those for the lower half are made 30 1/4 inches square.

Both the upper and lower spinner halves can be blanked and drawn on a 350- or a 400-ton capacity Verson hydraulic press. Since both of these double-action presses can also be used to form the tub basin halves, as will be described later, considerable flexibility is attainable in varying the production of different parts to suit requirements.

The presses are each equipped with four small hydraulic cylinders, which exert uniform pressure on the blank-holding ring to prevent the cup from wrinkling, and a large hydraulically actuated ram and cushion for drawing to the desired shape. Two pieces of scrap are produced from each square blank, and the finished cups are approximately 20 1/2 inches in diameter by 7 inches deep. The cycle takes 0.155 minute with the punch and cushion up for unloading and reloading, and 0.120 minute with the punch and cushion down.

The bottom of either upper or lower spinner halves is trimmed by a cam-actuated die, and the top of the lower half is blanked in the same operation on a 250-ton mechanical press. A close-up view of the die is seen in Fig. 1. As the ram descends, eight cams, mounted on the sides, front, and back of the ram, slide the four cutting members of the die toward the center of the press, thus trimming the part. When the ram rises, four springs return the cutting members to their original positions. The scrap that collects on the bolster plate under the dies is removed periodically. For the trimming operation, the part is inverted when it is placed in the die. The press is operated at eight strokes per minute, giving a production of 480 parts per hour.

One hundred and thirty-five holes, 3/16 inch in diameter, are then pierced in the bottom of the inner tub lower half on a 200-ton mechanical press. In the same operation, the blanked opening in the top of the part is flanged for subsequent roll seam welding. The punches are oiled periodically, after producing about twenty pieces, by means of a hand-pump oil-can. Slugs sticking to the die are removed when necessary. On the same press, in another operation, the top of the spinner upper half is finish-curled. Completed upper and lower halves of the spinner are seen at the left and right, respectively, in Fig. 2.

Upper and lower halves of the inner tubs are joined by roll seam welding on the Progressive 200-KVA air-operated welder shown in Fig. 3. The welder is equipped with synchronous electronic controls; phase-shift heat control; a variable-speed, motor-driven upper knurl for rotating the copper welding wheel; and a specially designed work-holding fixture. For the operation, the spinner halves are positioned on the fixture and securely gripped by air-operated clamps. It requires about 3 1/2 seconds for the fixture to close and the water-cooled welding wheel to be lowered to the work.

The complete circular welding cycle is completed automatically in about thirty-five seconds, after which the wheel rises and the fixture opens in about three seconds more. This results in a production of approximately eighty-six spinners per hour. Welding flash is ground from the inner wall of the tub assembly and wire-brushed

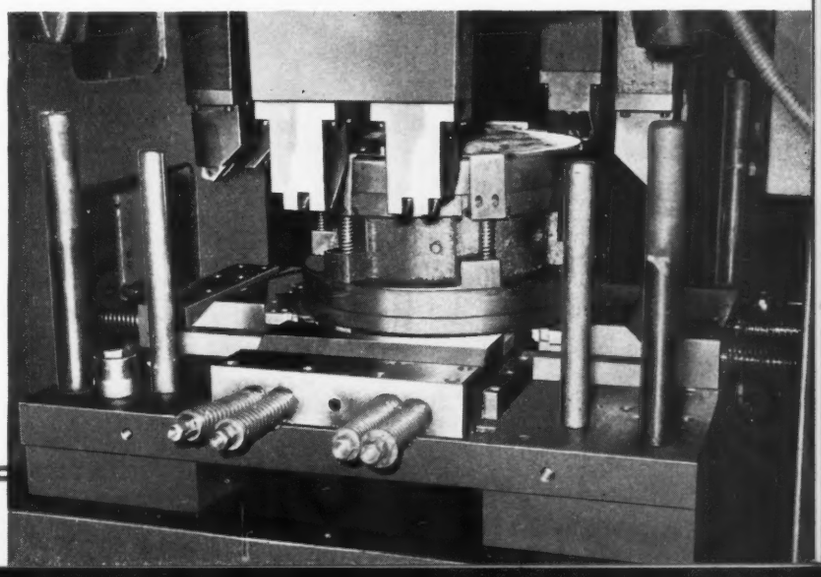

Fig. 1. Cam-actuated trimming die, mounted on a 250-ton mechanical press, is employed to square the bottom of both upper and lower spinner halves

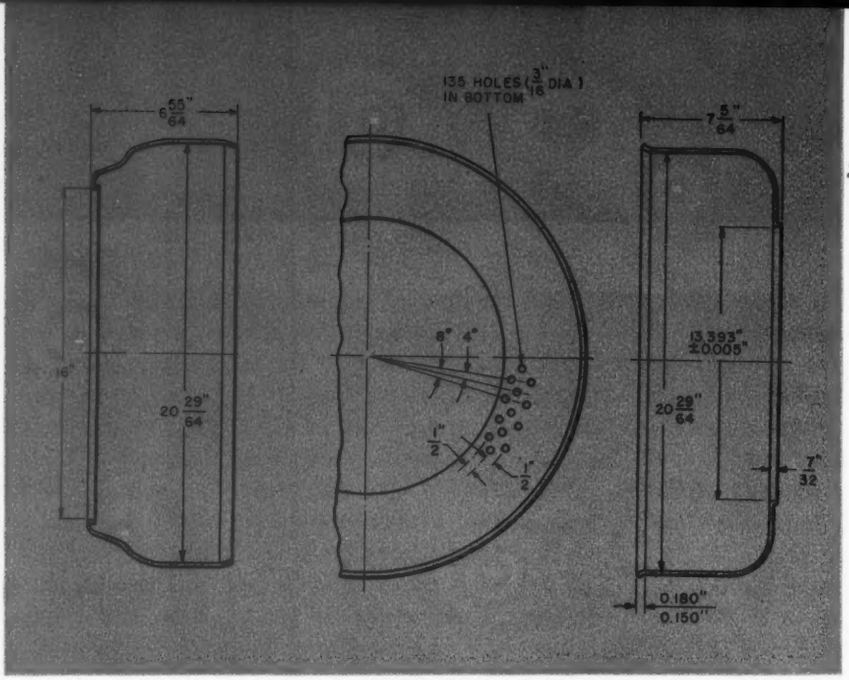

Fig. 2. (Left) Upper half and (right) lower half of the inner tub or spinner. The halves are roll seam welded on machine seen in Fig. 3

from the outer wall. After finishing, the inside of the inner tub appears as if it had been made from one piece.

A most unique operation is then performed on the inner tub assembly. This consists of the piercing of 1080 holes in the wall of the tub in one automatic cycle on a Verson 300-ton mechanical press, Fig. 4. All the holes are pierced from the inside to prevent burrs from forming within the tub.

Since it would be impossible to space the punches sufficiently close to pierce all the holes at once, 180 are pierced with each stroke of the ram, and the tub is automatically indexed six times to complete the operation. Six of the holes, spaced equally around the periphery of the tub to receive the bolts that fasten the spinner to the tub, are 19/32 inch in diameter, and the remaining 1074 holes are 3/16 inch in diameter. The larger holes are also embossed in the same operation, a depression being formed around the periphery of each of these holes.

A close-up view of this unusual perforating die with the inner tub assembly removed is seen in Fig. 5. The 180 punches, 90 of which are mounted on each of two horizontal slides in the center of the die, are driven outward to pierce the work by vertical acting cams on the ram of the press which engage cam surfaces on the slides carrying the punches. The vertical cams act from both top and bottom of the die to equalize the pressure exerted in spreading the punches apart. Simultaneously, vertical acting cams on each side of the ram move the horizontal slides on which the die buttons or punch bushings are mounted toward the work.

All the horizontal slides are returned to their original positions by spring action when the ram rises. The work is automatically indexed one-sixth of a revolution each time the ram rises, and the cycle automatically repeats itself. The work is located and held on the index-plate by pins which fit into holes previously pierced in the bottom of the tub. When the ram rises after its sixth stroke, a lever is shifted to retract the holding pins.

Because of both the upper and lower cam action on the piercing punches, a relatively long ram stroke of 30 inches is required. This, of course, slows the cycle, so that a production of only one per minute can be obtained from each press. Since the spinner is cylindrical in shape, the holes and slugs produced by the round punches are slightly elliptical. The slugs are pushed through the die buttons by the punches into two tubes at the rear of the press from which they are blown by compressed air into receivers.

Lubricant is sprayed liberally on the inner wall of every fifth inner tub assembly prior to piercing. A film of lubricant is also applied over a 60-degree arc on the outer wall of every other tub assembly. A specially shaped magnetized file is employed to remove any slugs that may remain in the die. After each tub has been pierced, the file is passed around the entire circumference of the locating ring to insure the removal of all slugs.

Since each high-speed steel punch pierces only six holes in each spinner, the tool life is relatively long. To avoid any interruptions in the high-production schedule, however, the die is completely disassembled and overhauled at the end of every week.

After a 100 per cent inspection to check the over-all height, diameters, and squareness of the

inner tub assembly, the tubs are washed, dipped into an acid pickling solution, and coated with a small amount of nickel to provide a good adhesive base for the porcelain enamel finish. Upon the completion of the enamel spraying operation, the parts are placed on an overhead conveyor and passed through gas-fired baking furnaces.

Tub basins, which encase the spinners in the automatic washing machines, are also made by seam-welding the upper and lower halves together. Both halves are formed from round, flat blanks of deep-drawing, cold-rolled enameling steel, 42 1/2 inches in diameter. Blanks for the lower section of the tub basin are 16 gage (0.0598 inch thick), while those for the upper section are 19 gage (0.0418 inch thick).

Lower sections of the tub basin are formed at the rate of 125 per hour on a line of four Verson presses. In the first operation, which is the most difficult one performed on any component of the washer, the round blank is drawn into a shallow cup about 4 inches deep and 23 inches in diameter, as seen at the left in Fig. 6. This is a reduction in blank size of 46 per cent, 6 per cent more than that normally obtained in such operations. Three other operations are performed simultaneously as the ram nears the bottom of its stroke. A triangular-shaped clearance sump, 2 7/8 inches deep, is formed in the periphery of the shallow cup; a ball-seat sump, 7 inches in diameter and 3/4 inch deep, is drawn in reverse in the center of the cup bottom; and a conical-shaped drain sump, 4 1/2 inches in diameter and 2 inches deep, is drawn in the opposite direction between the clearance and ball-seat sumps.

Considerable tonnage and an expensive die are required to form and maintain the desired shapes because the metal is being drawn in three directions at the same time, and wrinkles must be avoided.

This drawing operation is performed on a full eccentric type, two-point suspension mechanical press having a capacity of 300 tons near the bottom of the stroke, Fig. 7. The press is equipped with a delayed-action type combination hydraulic-pneumatic cushion.

The blank, precoated with lubricant by means of the "Dri-Coat" process, is slid into the die and positioned against two locating pins. The complete cycle time is approximately 0.120 minute per part, with the press operating at about eight strokes per minute. As the punch ascends, and

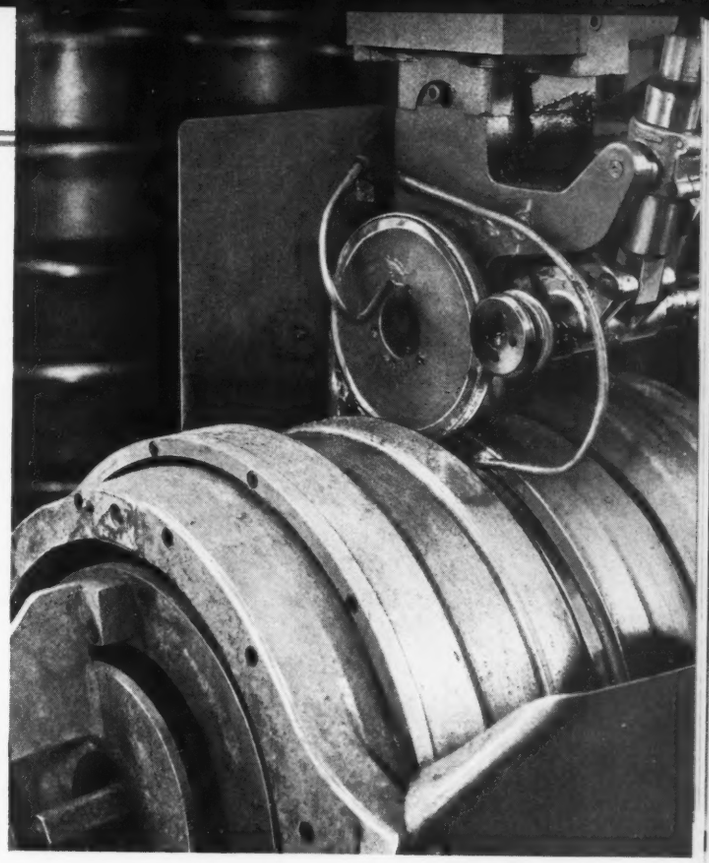

Fig. 3. Air-operated roll seam welding machine, of 200-KVA capacity, employed to join upper and lower halves of the inner tub together

Fig. 4. As many as 1080 holes are pierced in the wall of the inner tub assembly in one automatic operation on a 300-ton mechanical press with the set-up illustrated

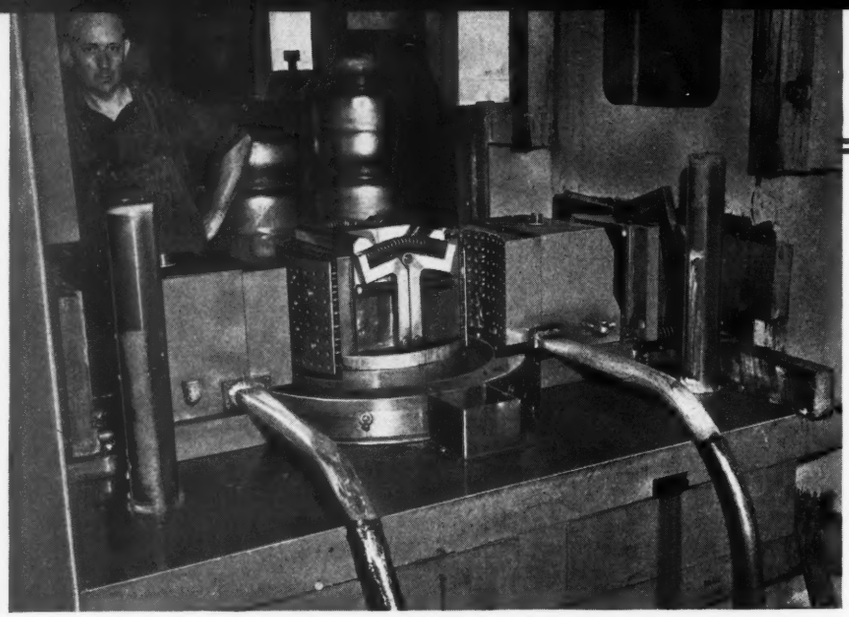

Fig. 5. Close-up view of unusual cam-actuated piercing die shown in Fig. 4, with tub removed to show punches and die buttons. For this operation, 180 punches are employed

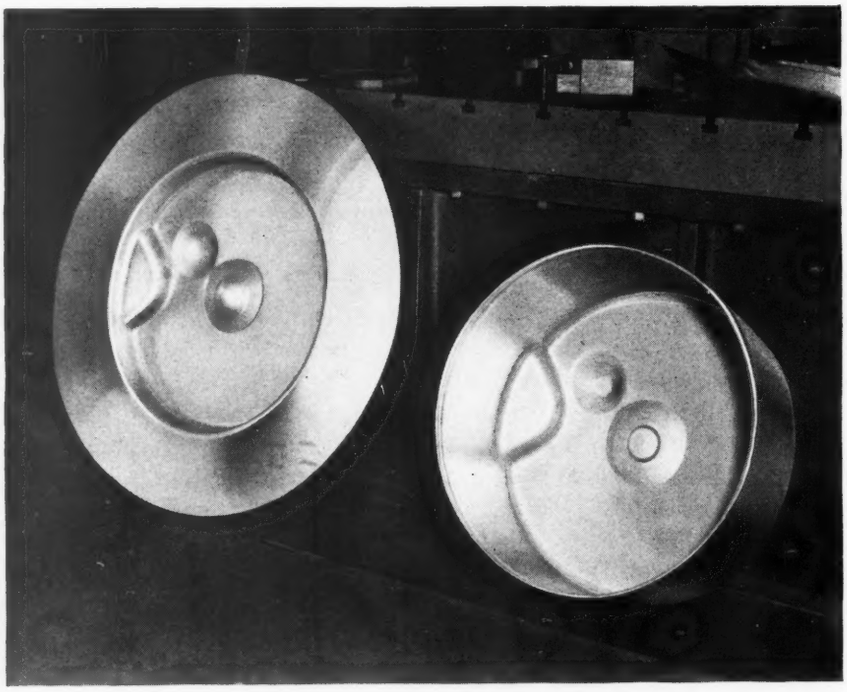

Fig. 6. A shallow cup formed in first drawing operation on tub basin lower section is seen at left, while redrawn cup is shown at right

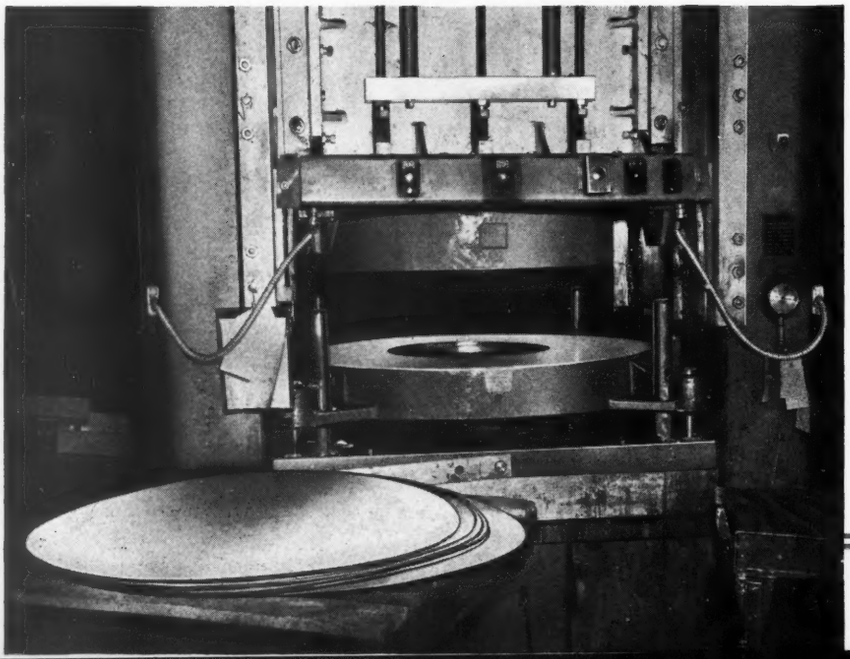

Fig. 7. A 300-ton mechanical press is used for the first draw on lower tub basins. The press is equipped with a combination hydraulic-pneumatic cushion

the cushion rises, the part is removed from the die and placed on a roller conveyor leading to the next press.

The depth of the cup is increased to 14 inches in the second and final drawing operation. This is performed on a double-action hydraulic press of 400 tons capacity. During this operation, the center sump is also redrawn. The redrawn lower section of the tub basin is seen at the right in Fig. 6.

Following the drawing, the part is inverted and placed in a die mounted on a 250-ton mechanical press for cam-trimming, and for straightening and piercing the neck in the center sump. The slug formed by the piercing die is removed from the sump neck by a suction cup, held in the operator's hand, when the part is removed from the die.

The last operation performed on the lower section of the tub basin before it is welded to the top section consists of piercing the conical-shaped drain sump and curling or flanging the neck in the center sump. This is performed on a 200-ton mechanical press with the set-up shown in Fig. 8.

Upper sections of the tub basin are completed in three operations. The round blanks, 42 1/2 inches in diameter by 19 gage, are drawn to a depth of 14 1/2 inches and a diameter of 26 inches on a 350-ton single-action hydraulic press, Fig. 9. This deep-drawing operation is particularly difficult because the walls of the part must flare inward, toward the bottom, on a 14 1/2-inch radius. The drawn shape is then trimmed, its top is blanked out, and five holes are pierced in the side wall. All of these operations are performed simultaneously on a 300-ton mechanical press. Finally, the top edge of the upper tub basin is curled on a 200-ton mechanical press, Fig. 10, for subsequent application of a rubber seal.

After welding damper spring brackets, a drainspout, and leg brackets to the lower section of the tub basin, it is joined to the upper half by circular seam welding on a Progressive 150-KVA air-operated welder similar to the machine employed for welding together the inner tub halves. The tub basin sections are positioned on the welding machine fixture with the upper section over four centering rolls, and the center hole in the bottom of the lower section over the shaft of a foot-controlled air clamp. The automatic welding cycle requires approximately 0.85

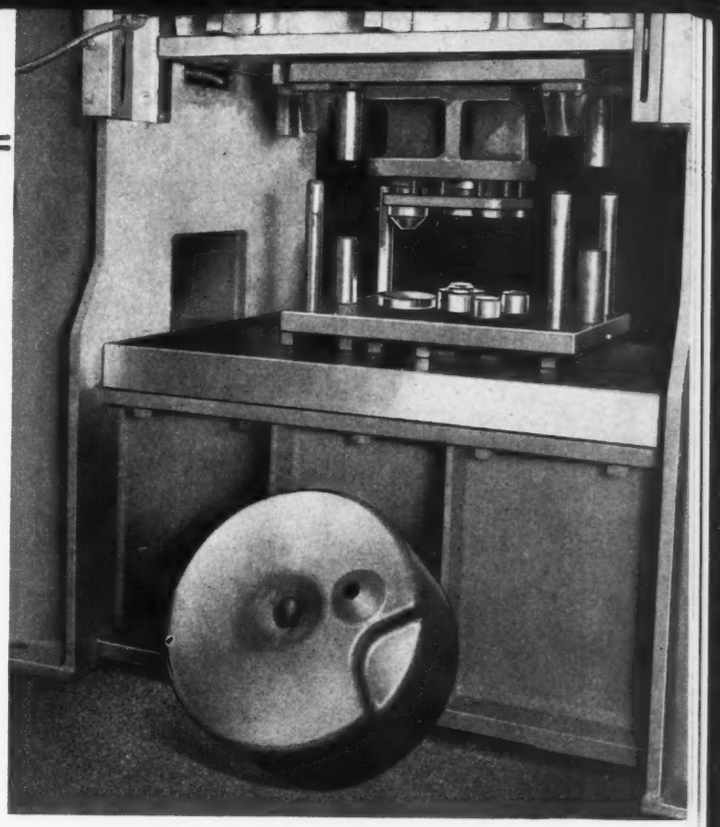

Fig. 8. Die employed for piercing and flanging sumps previously formed in the bottom of the tub basin lower sections

Fig. 9. Upper sections of the tub basins for automatic washers are drawn from round blanks on the 350-ton single-action hydraulic press here illustrated

Fig. 10. In this operation on a 200-ton mechanical press, the top edge of the upper tub basin is curled to accommodate a rubber seal

minute, resulting in a production of about 60 tub basins per hour.

The completed tub basins are given a 100 per cent inspection, submerged in water to test for leaks, and finished with porcelain enamel.

An interesting step in producing the cabinet for the automatic washing machine is illustrated in Fig. 11. Two dies are mounted on this 300-ton hydraulic press. The parts come to this press as flat sheets (19 gage) which have been blanked, notched, and louvered in previous operations. The die mounted on the far side of the press flanges the edges of the flat sheet downward, 12 1/4 inches from each end, to form 3/4 inch radii on the rear corners of the cabinet. In the same operation, the lower edge in the center of the blank is drawn to form a depressed, toe-clearance board.

The partially formed cabinet is then slid forward to the second die (seen in the foreground) where the center section is stretch-formed to produce a 100-inch radius on the front of the cabinet and 2-inch radii on the front corners. Four angularly mounted hydraulic cylinders are suspended from the press ram, two along each side. As the ram descends, dies mounted on the rams of these cylinders stretch the blank around the form block on the bed of the press.

A cabinet is completed with each stroke of the press ram, the complete cycle requiring 0.21 minute, which gives a production of about 200 cabinets per hour. A finish-formed cabinet is seen in the left foreground of Fig. 11.

The fabrication of sheet metal is a relatively new undertaking for the Maytag Co., the sheet-metal shop having been in operation less than two years. An interesting point in this connection is the impressive safety record attained in this shop, there having been no lost-time accidents since the start of operations. Safety devices or press attachments such as barrier guards, pull-back devices, or swinging arms are not employed. However, two hand trip controls are provided on each press, requiring both levers or buttons to be depressed simultaneously.

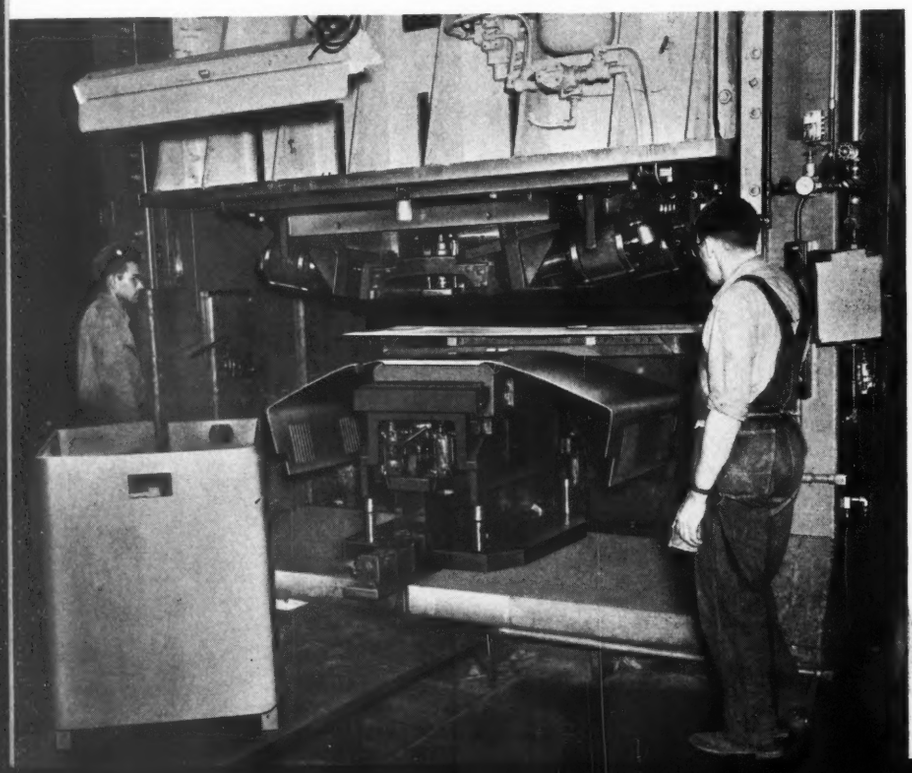

Fig. 11. Two dies mounted on a 300-ton hydraulic press are employed to form the rounded corners and stretch-form the front of the washer cabinet

Increases in Real Wages Can Come Only with Greater Productivity

LABOR leaders and left-wing politicians have created the delusion that the working man is better off with each cycle of wage increases. Even President Truman has added to this delusion with his recent statement that, in fifty years, the average income is to be tripled to around $10,000. An income of that high figure will not mean a thing unless it will buy more than today's average income.

Real increases in wages can come only with increased productivity per man-hour because of the simple but inescapable fact that to have more we must produce more. More money without more goods means only higher prices. It is, therefore, no less important to labor than to manufacturers and consumers that productive efficiency be continuously increased.

Our great national wealth was derived from our high productivity. During past generations productive efficiency per man-hour increased an average of 2.5 per cent every year, but this trend came to a halt in the last war and has not been renewed to the former extent, so that the productive efficiency in most of the factories is much lower than it would have been if the traditional rate of increase had been maintained.

A recent study entitled "How to Raise Real Wages," issued by the Research and Policy Committee of the Committee for Economic Development, points out that a threefold increase in real wages per hour took place in the United States during the last fifty years. In addition, products of much better quality and greater variety are available. Because wages buy more goods than in 1900, men do not have to work as long to support themselves and their families, and therefore have more leisure time in which to enjoy themselves.

Our tremendous advances in the first half of this century were due to the sevenfold substitution of mechanical energy for human and animal energy, and to the universal adoption of quantity production methods made possible by the brains and engineering skill of the manufacturers of machine tools and other production machinery. The C.E.D. report suggests the following five ways to increase man-hour efficiency: (1) Better methods; (2) more capital; (3) better training of workers; (4) better management; and (5) more interested workers.

Ten suggestions are then made as to how these objectives might be achieved, but no mention is made about the opposition of labor leaders to the utilization of modern manufacturing equipment that could bring a tremendous increase in productive efficiency overnight if it were substituted for the obsolete equipment that is being used in many factories. This attitude of the labor leaders, together with the severe policy of the Treasury Department with regard to the depreciation of new manufacturing equipment, is retarding the revival and encouragement of increases in productive efficiency—the foundation for increases in real wages and a higher living standard for all.

How can these obstacles be overcome? Only by enlisting the aid of the consuming public, enlightened labor leaders, and politicians who hold the welfare of the nation above partisan politics. They must learn the fundamental principle that increases in real wages can come only from higher individual productive efficiency.

Charles O. Herb

EDITOR

Design of Involute Gear

A HOB may be regarded as a parallel worm having an involute thread that has been fluted and relieved to provide cutting edges. If this worm is placed in contact with a gear blank, and then fed to depth in the blank, while both rotate in synchronism, teeth of involute form will be generated in the gear blank. By giving the hob a traversing motion parallel to the gear axis, the teeth will be generated uniformly across the face of the gear.

It is usual, in addition, to give the hob a small component of motion along its own axis, so that the whole of the hob thread comes into action. This distributes the wear evenly, and thus increases the working time before resharpening is necessary. The hob, by virtue of its large number of cutting faces, is the most satisfactory cutting tool for large gears, provided they are of standard pitch.

Occasionally it is suggested that a hob may be regarded as a series of rack cutters arranged in a helical path around the hob boss. This analogy, however, is incorrect, and if used for design purposes, results in a cutter that does not produce gears of true involute form. In many cases, however, the error is very small and may be justifiably ignored.

Hobs for cutting straight-toothed gears are usually made with a single-start thread, while for helical gears multi-start hobs are commonly used.

Theoretically Correct Hob Thread Form

For design purposes, it is essential that the thread form of a theoretically correct hob should be known. This may be easily determined by considering the action of a single-start, unfluted and unrelieved worm with a rack gear.

Referring to Fig. 1, which shows various views of this worm and rack, let

R_{ph} = pitch radius of hob;
R_{bh} = base-circle radius of hob;
a_n = pressure angle of rack teeth in normal plane;
L = lead of hob thread;
ϕ = pressure angle of rack teeth in plane XX;
P_{cn} = normal pitch of rack teeth.

Also, let the lead angle of the hob thread measured at the pitch radius be:

$$\tan \theta = \frac{L}{2\pi R_{ph}}$$

or

$$\theta = \tan^{-1}\left(\frac{L}{2\pi R_{ph}}\right)$$

Then, for correct action between the worm thread and the rack gear, it is imperative that both normal pitches be equal, and that the pressure angles of both in any particular plane be equal. Hence:

P_a (Axial pitch of worm thread) $= P_{cn} \sec \theta$ (1)

and

$$R_{bh} = R_{ph} \cos \phi \qquad (2)$$

Since, in the enlarged view at Z showing a section of the rack tooth, abd lies in the plane XX, it follows that

$$\phi = \tan^{-1}\left(\frac{bd}{ab}\right)$$

$$= \tan^{-1}\left(\frac{bc}{ab} \times \frac{bd}{bc}\right)$$

$$= \tan^{-1}\left(\frac{\tan a_n}{\sin \theta}\right) \qquad (3)$$

In addition, since efk passes through the pitch point f, and is at right angles to afd, it can be seen that efk is the projection in the plane XX of the line of contact between the rack profile afd and the hob profile pfr. The actual line of contact must lie in the plane of the rack tooth flank, and may be represented by sft.

Through c a line is drawn parallel to sf to meet ad at w; and through w a line is drawn parallel to fe to meet bd at v. Then the triangles efs and vwc are similar, so that angle efs = angle $vwc = \sigma$ which is given by

$$\sigma = \tan^{-1}\left(\frac{vc}{vw}\right)$$

$$= \tan^{-1}\left(\frac{bc \cos \theta}{bc \cos \theta \cot \theta \cos \phi}\right)$$

$$= \tan^{-1}\left(\frac{\tan \theta}{\cos \phi}\right) \qquad (4)$$

$$= \tan^{-1}\left(\frac{\frac{L}{2\pi R_{ph}}}{\frac{R_{bh}}{R_{ph}}}\right)$$

$$= \tan^{-1}\left(\frac{L}{2\pi R_{bh}}\right) \qquad (5)$$

Thus, for a worm to mesh correctly with an

Hobbing Cutters

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involute rack gear, or to generate such a rack gear, the thread must be formed by a straight line *tfs* revolving around, advancing with uniform lead along, and tangent to the base cylinder of the hob. The base cylinder diameter of the hob is such that the lead angle of the thread at this diameter is equal to the angle between the straight line *tfs* and the plane *XX*. Such a thread is known as an involute helicoid.

Approximate Hob Thread Form

If, however, the hob is regarded as a series of rack cutters arranged in a helical path, then the flank angle of the thread in an axial section should be equal to the pressure angle of the rack tooth in the same section. Let this pressure angle be a_r. Then

$$a_r = \tan^{-1}\left(\frac{\tan a_n}{\cos \theta}\right) \qquad (6)$$

A thread of this form may be generated by a straight-edged tool, set in an axial plane of the hob.

To determine the error caused by using this rack thread form, equations may be developed giving the profile in an axial section of a correct thread form.

Referring to Fig. 2, let:

- *abc* represent the thread profile in a section at right angles to the hob axis;
- *zz* represent the axial section in which the thread profile is required to be known;
- *p* be a point in this axial section and on the base helix; and
- *q* be a point in the axial section and on the involute *abc*.

Then x = axial displacement from p to q

$$= \frac{L}{2\pi} \times \text{angle } poa$$

$$= \frac{L}{2\pi}(\tan \triangle - \triangle) \qquad (7)$$

where $\triangle = \cos^{-1}\left(\frac{R_{bh}}{R_{bh} + y}\right)$ (8)

and y = radial displacement from p to q.

Since the thread surface consists of an infinite number of involutes similar to *abc* but springing from an infinite number of points along the

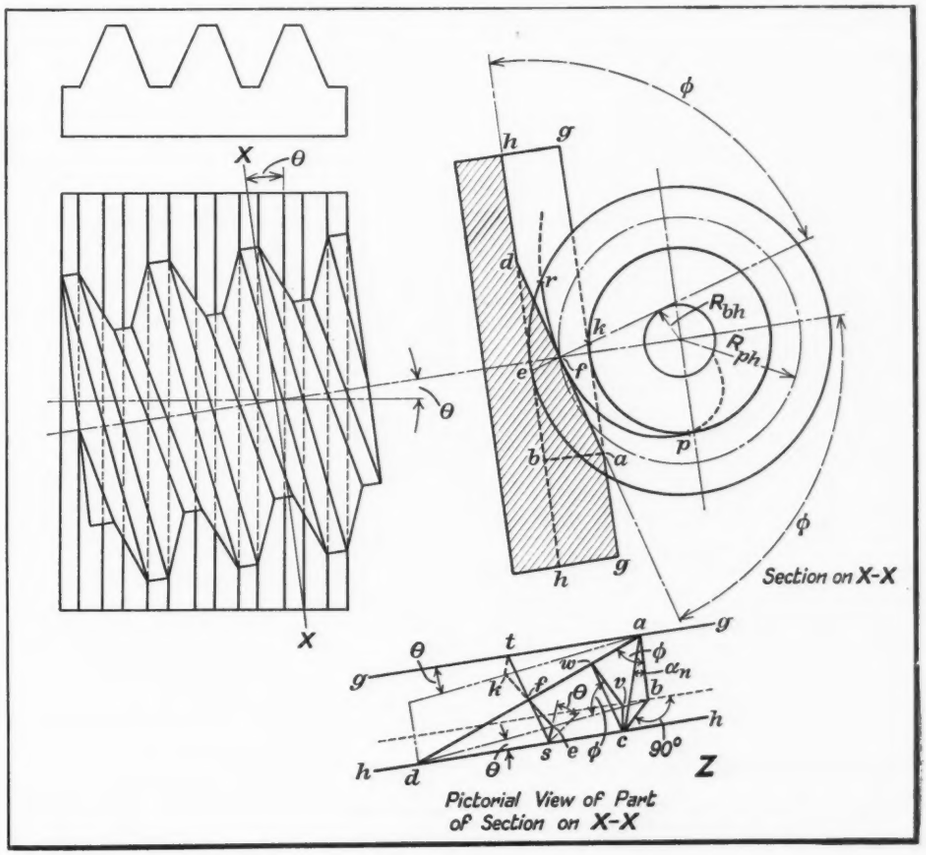


Fig. 1. Diagram showing a single-start, unfluted and unrelieved involute worm in mesh with a rack gear

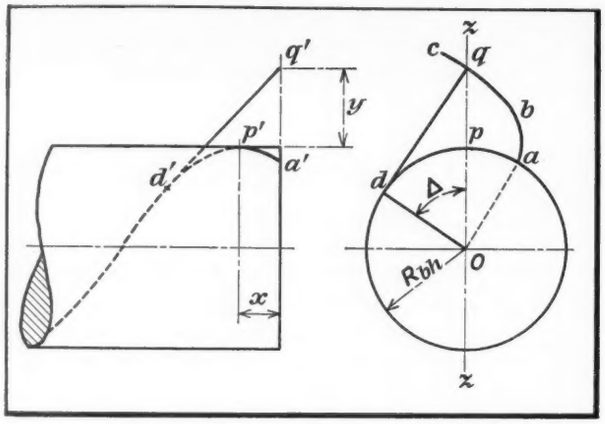


Fig. 2. Method of determining the profile in an axial plane of a theoretically correct hob form

base helix, it follows that by giving a number of numerical values to y, corresponding values for x may be found. These figures represent coordinates of the thread profile in the axial plane zz with respect to p, the datum point. Using these figures, a determination may be made of the profile error resulting from a thread form that is straight sided in an axial section.

Calculations show that, in the case of a hob of 4.5 inches pitch diameter, to cut gears of 5 normal diametral pitch, and 20-degree normal pressure angle, the profile error does not exceed 0.0001 inch for a single-start hob. The maximum error for a two-start hob is 0.0004 inch, and for a three-start hob, 0.0007 inch. In all cases, the error is positive; that is, the hob thread is thick at crest and roots, if correct at the pitch line, so that the teeth which it cuts will have a small degree of tip and root relief. Consideration of the figures shows that, in the case of the single-start hob at least, the error is negligible. For a three-start hob, however, the error reaches an appreciable value. In spite of this, the approximate thread form is generally used for all hobs.

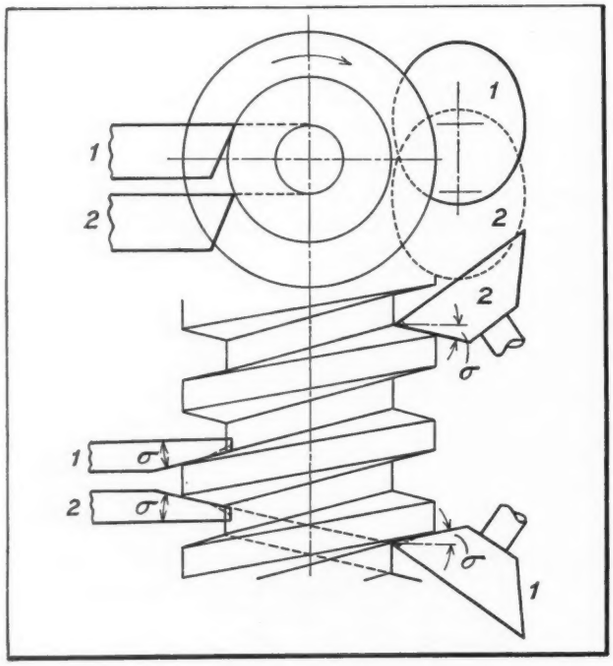


Fig. 3. Diagram indicating tool settings for generating correct hob form

Cutting True Hob Form

An unrelieved, ungashed hob thread, of theoretically correct form, may be made as indicated in Fig. 3. The hob thread may be turned by a pair of tools, offset so that their cutting edges are tangential to the base cylinder of the hob, and inclined at the angle σ to the transverse plane of the hob. One tool must be placed above the hob axis and the other below the hob axis, so that the cutting edge is tangential to the base helix in each case. The diagram also shows a pair of grinding wheels for grinding the thread. A certain amount of root rise on the hob thread may be provided by imparting a small relief to the cutting and grinding tools, as shown by the dotted lines.

For the hob to be capable of cutting teeth, the thread must be gashed and relieved, whether the thread is of correct or approximate form. The gashing of the thread may be axial or helical. Axial gashing presents simpler design problems, but helical gashing, if normal to the thread, provides stronger cutting edges. The cutting face is usually radial, since the complication with any other form renders the calculations exceedingly tedious.

Relief for Hob with Axial Flutes

Considering, in the first instance, the case of a hob having axial flutes, relief on the tooth flanks will increase the lead on one side of the thread and reduce it on the other side.

Let r = radial relief per flute and N = number of flutes or gashes. Then, referring to Fig. 4, which shows a development of a hob tooth, since the hob thread in an axial section approximates closely a straight-sided rack tooth of flank angle a_r, it follows that, assuming the relief is at a uniform rate, measured circumferentially,

L_m = modification of lead of hob due to relief;
= $N \times$ (modification of thread advance per flute due to relief);
= $N\, r \tan a_r$ (9)

to a very high degree of accuracy.

Hence

θ_g = hob lead angle at pitch radius on thread side having increased lead

$$\theta_g = \tan^{-1}\left(\frac{L + L_m}{2\pi R_{ph}}\right) \quad (10)$$

and

θ_l = hob lead angle at pitch radius on thread side having reduced lead

$$\theta_l = \tan^{-1}\left(\frac{L - L_m}{2\pi R_{ph}}\right) \quad (11)$$

Although the thread relief modifies the thread lead angle, it is obvious that it must not affect the cutting profile in any way. In the case of a hob being manufactured by the approximate method, it can be seen that the relief has no effect whatsoever on the hob tooth profile, since the cutting tool profile lies in the same plane as the hob tooth profile, and has a planar motion. If, however, the hob is being manufactured to correct form, the relief motion will affect the cutting profile unless special precautions are taken, since the cutting tool profile does not lie in the same plane as the hob tooth profile.

Now, as shown by Equation (6),

$$\alpha_r = \tan^{-1}\left(\frac{\tan \alpha_n}{\cos \theta}\right)$$

Therefore, for the value of α_r to remain constant, it is obvious that the value of α_n must be altered to counteract variations in the value of θ. So that, if

α_{ng} = basic-rack pressure angle for hob thread on the side having increased lead; and

α_{nl} = basic-rack pressure angle for hob thread on side having reduced lead; then

$$\alpha_r = \tan^{-1}\left(\frac{\tan \alpha_{ng}}{\cos \theta_g}\right)$$

$$= \tan^{-1}\left(\frac{\tan \alpha_{nl}}{\cos \theta_l}\right)$$

Hence $\alpha_{ng} = \tan^{-1}(\tan \alpha_r \cos \theta_g)$ (12)

and $\alpha_{nl} = \tan^{-1}(\tan \alpha_r \cos \theta_l)$ (13)

This means that, due to the relief, the hob thread must be generated from rack gears having a pressure angle different from that which such a hob will generate. The modifications of the basic-rack pressure angle will modify the base-circle radius and the tool setting angle. So that, if

R_{bhg} = base-circle radius of hob thread for thread side having increased lead;

R_{bhl} = base-circle radius of hob thread for thread side having reduced lead;

σ_g = lead angle of hob thread at base-circle radius on side having increased lead; also tool setting angle for thread side having increased lead;

σ_l = lead angle of hob thread at base-circle radius, on side having reduced lead; also tool setting angle for thread side having reduced lead

then, by analogy with the equations developed earlier,

$$R_{bhg} = R_{ph} \cos\left\{\tan^{-1}\left(\frac{\tan \alpha_{ng}}{\sin \theta_g}\right)\right\} \quad (14)$$

$$R_{bhl} = R_{ph} \cos\left\{\tan^{-1}\left(\frac{\tan \alpha_{nl}}{\sin \theta_l}\right)\right\} \quad (15)$$

$$\sigma_g = \tan^{-1}\left(\frac{L + L_m}{2\pi R_{bhg}}\right) \quad (16)$$

$$\sigma_l = \tan^{-1}\left(\frac{L - L_m}{2\pi R_{bhl}}\right) \quad (17)$$

Relief for Hob with Helical Flutes

If, however, the flutes are helical instead of axial, then one cutting edge of a tooth is in advance of the other, so that the tooth, in an axial section, must be distorted. This distortion is due to the side of the tooth containing the leading edge being affected more by the relief than the side containing the trailing edge. In most cases, the flutes are normal to the thread. Assuming that the flutes are normal to the thread, and referring to Fig. 5, let

L_f = lead of flutes;

β_t = distortion angle of top land in an axial section;

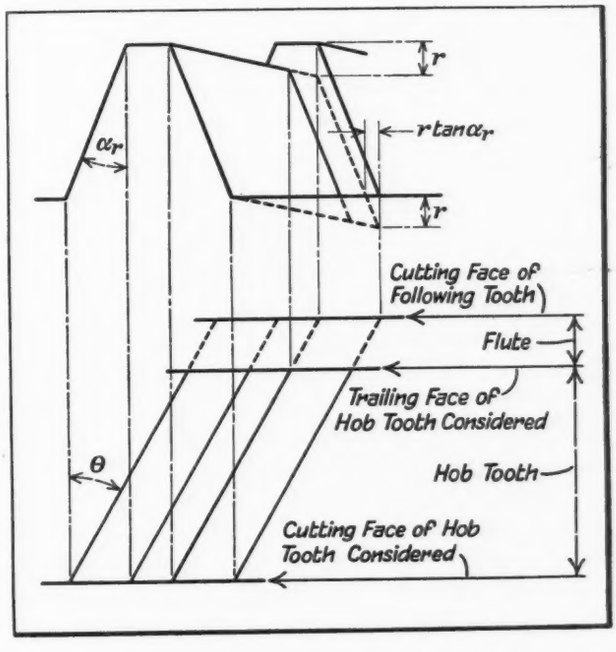


Fig. 4. Development of hob tooth for axially fluted hob

β_l = flank angle of thread in an axial section, at pitch radius, on side having reduced lead;

β_g = flank angle of thread in an axial section, at pitch radius, on side having increased lead.

Then

$$L_f = 2\pi R_{ph} \cot \theta \tag{18}$$

and

$$\beta_t = \tan^{-1}\left(\frac{bc}{ab}\right)$$

But

$$bc = ab \sin\theta \left(\frac{r}{\frac{2\pi R_{ph} \cos\theta}{N}}\right)$$

Hence

$$\beta_t = \tan^{-1}\left(\frac{Nr \sin\theta \sec\theta}{2\pi R_{ph}}\right)$$

$$= \tan^{-1}\left(\frac{N r}{2\pi R_{ph} \cot\theta}\right)$$

$$= \tan^{-1}\left(\frac{N r}{L_f}\right) \tag{19}$$

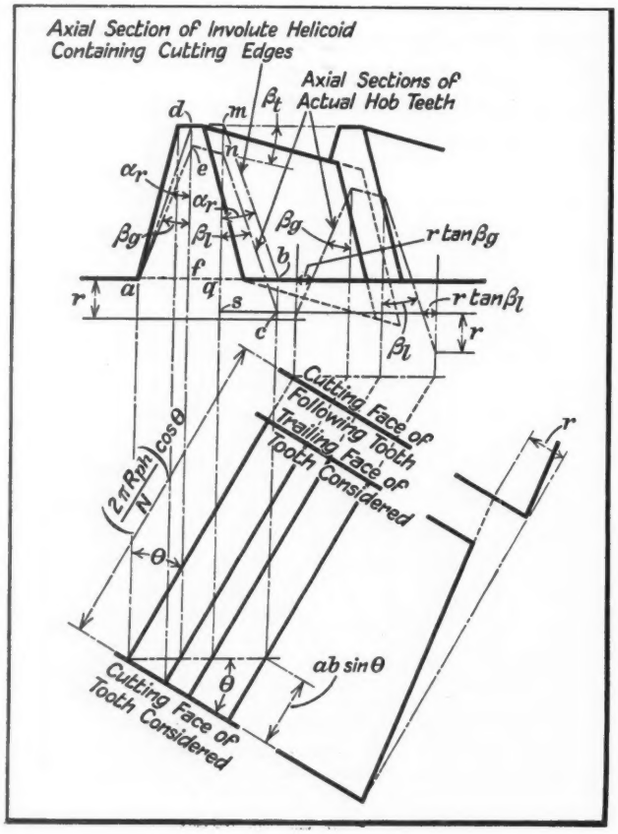

Axial Section of Involute Helicoid Containing Cutting Edges
Axial Sections of Actual Hob Teeth
Cutting Face of Following Tooth
Trailing Face of Tooth Considered
Cutting Face of Tooth Considered

Fig. 5. Development of hob tooth with flutes normal to the thread

Again

$$\beta_g = \cot^{-1}\left(\frac{ef}{af}\right)$$

$$= \cot^{-1}\left(\frac{df}{af} - \frac{ed}{af}\right)$$

$$= \cot^{-1}\ (\cot a_r - \tan \beta_t) \tag{20}$$

and similarly

$$\beta_l = \cot^{-1}\left(\frac{ns}{sc}\right)$$

$$= \cot^{-1}\left(\frac{mq + qs - mn}{sc}\right)$$

$$= \cot^{-1}\left(\frac{mq}{sc} + \frac{qs - mn}{sc}\right)$$

$$= \cot^{-1}\ (\cot a_r + \tan \beta_t) \tag{21}$$

In this instance, for a hob thread of the approximate form, as well as for one of the correct form, the relief will modify the tool settings. For a hob of the approximate form, the tool setting angles should be β_g and β_l on the respective sides of the thread, instead of a_r on both sides. It is very common, however, for such a hob to be manufactured with the same settings as for a hob having axial flutes.

For a hob of the correct form, the modification of lead of thread due to relief on the side having increased lead is

$$L_{mg} = Nr \tan \beta_g \tag{22}$$

and modification of lead of thread due to relief on the side having reduced lead is

$$L_{ml} = Nr \tan \beta_l \tag{23}$$

whence θ'_g = lead angle of thread on side having increased lead;

$$= \tan^{-1}\left(\frac{L + L_{mg}}{2\pi R_{ph}}\right) \tag{24}$$

and θ'_l = lead angle of thread on side having reduced lead;

$$= \tan^{-1}\left(\frac{L - L_{ml}}{2\pi R_{ph}}\right) \tag{25}$$

For the hob thread to have flank angles β_g and β_l in the axial plane, with lead angles θ'_g and θ'_l, the basic-rack pressure angles will be

a'_{ng} = basic-rack pressure angle for thread side having increased lead;

and a'_{nl} = basic-rack pressure angle for thread side having reduced lead.

Then

$$a'_{ng} = \tan^{-1}\ (\tan \beta_g \cos \theta'_g) \tag{26}$$

and

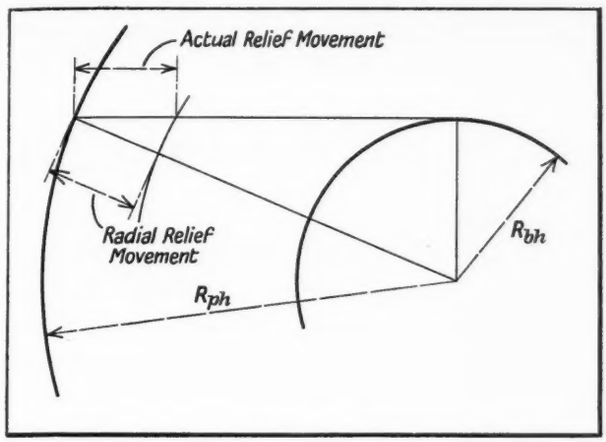


Fig. 6. Diagram showing the relation between actual and radial relief on a hob of correct form

$$\alpha'_{nl} = \tan^{-1}\ (\tan \beta_l \cos \theta'_l) \qquad (27)$$

Using these basic-rack pressure angles, new equations may be written down for the base circle radii and the tool setting angles. Thus, if

R'_{bhg} = base-circle radius of hob thread on side having increased lead;

R'_{bhl} = base-circle radius of hob thread on side having reduced lead;

σ'_g = tool setting angle on side having increased lead;

σ'_l = tool setting angle on side having reduced lead

Then,

$$R'_{bhg} = R_{ph} \cos \left\{ \tan^{-1} \left(\frac{\tan \alpha'_{ng}}{\sin \theta'_g} \right) \right\} \qquad (28)$$

$$R'_{bhl} = R_{ph} \cos \left\{ \tan^{-1} \left(\frac{\tan \alpha'_{nl}}{\sin \theta'_l} \right) \right\} \qquad (29)$$

$$\sigma'_g = \tan^{-1} \left(\frac{L + L_{mg}}{2\pi R'_{bhg}} \right) \qquad (30)$$

$$\sigma'_l = \tan^{-1} \left(\frac{L - L_{ml}}{2\pi R'_{bhl}} \right) \qquad (31)$$

Factors Affecting Hobs of Correct Form

These formulas enable a cutter of correct form to be designed, with either axial or helical flutes. It is usually assumed that such a hob will cut the same tooth form after sharpening as before sharpening. This view is manifestly incorrect, since the pitch radius of the hob is altered by sharpening. This alteration in pitch radius will affect the base-circle radii and the tool setting angles, so that the hob cutting profile will be correct at one stage only during its life; that is, when it has the standard pitch diameter.

There is another factor of considerable practical importance that militates against the use of hobs of correct form. The actual tool relief movement must be tangential to the appropriate base circle, the radius of which differs on the two sides of the thread. Since the radial relief affects the diameter of the hob, it follows that it must be the same on both sides of the thread. As a direct result, the actual cam lift will be different on the two sides of the thread. This will necessitate the manufacture of special cams for each hob unless some means can be found for the incorporation of variable-lift cams in the hob-generating machine. Fig. 6 shows how the actual lift may be determined.

These practical difficulties explain adequately why hobs are made normally to the approximate, rather than to the correct thread form.

* * *

Colonial "Dymon-Ize"-Sharpened Broaches

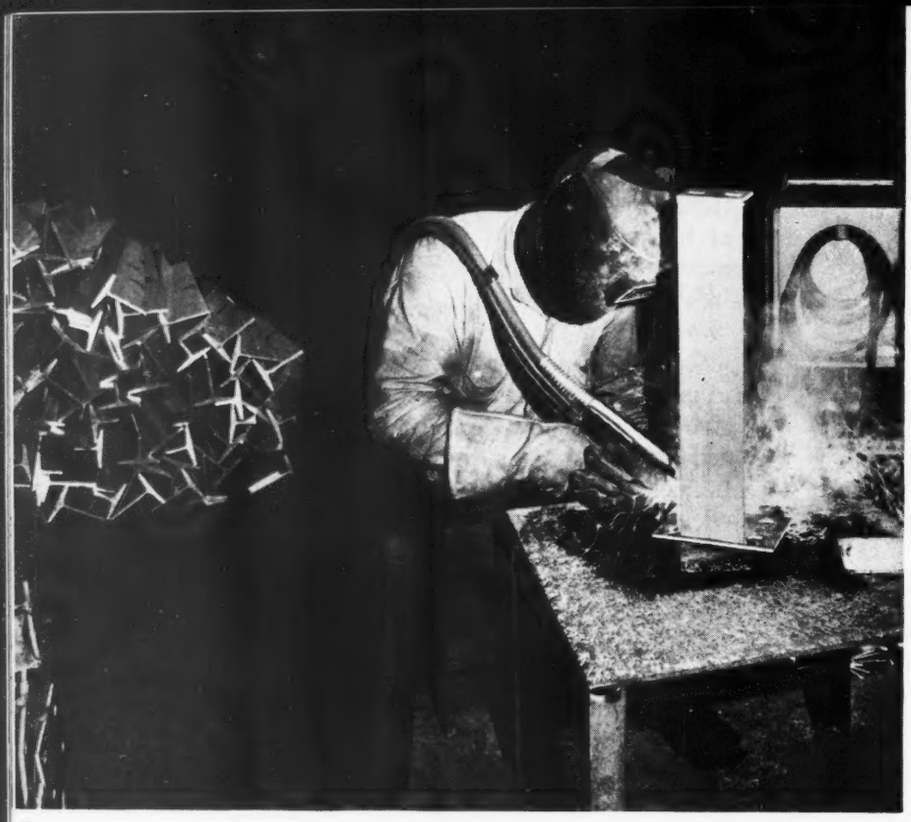
As a result of a new development in diamond dressing of grinding wheels, announced by the Colonial Broach Co., Detroit, Mich., a higher finish on the cutting surface of broaches has been made possible. This process, called "Dymon-Ize" sharpening, is said to increase the surface smoothness of broached surfaces by reducing the height of the minute "tool marks" at the cutting edges of the broach teeth.

It is stated that all Colonial broaches for applications requiring exceptional surface finish will be "Dymon-Ize"-sharpened in the future. "Dymon-Ize" diamond wheel-dressers are also to be available shortly from the company for resharpening of broaches by users.

* * *

General Electric Co.'s New Industrial Research Laboratory

The General Electric Co., Schenectady, N. Y., announces that the company's new industrial research laboratory is nearing completion, and it is expected that it will be fully occupied by late August. Construction on this laboratory structure was begun in 1946. Exclusive of minor service buildings, the laboratory plant consists of five buildings having a total area of about 185,000 square feet. These include the main five-story building; the Radiation Laboratory, where the 300,000,000-volt synchrotron and other atom-smashers will be installed; a low-temperature laboratory where helium will be liquefied for studying the effects at temperatures near absolute zero; and a chemical pilot plant.



Joining High

Parts Made of Stainless Steel, Aluminum, and Aluminum Bronze are Rapidly Welded in All Positions by Means of the "Aircomatic" Process. Typical Applications of This Inert-Gas Shielded Metal Arc-Welding Process are Described in This Article

CONSIDERABLE progress has been made in the production welding of aluminum, chrome-nickel stainless steel, and aluminum- and silicon-bronze parts by the use of the "Aircomatic" inert-gas shielded metal arc-welding process developed by Air Reduction Sales Co., New York City. This method employs a continuous filler wire electrode, fed through a gun (or an automatic welding head) and a nozzle that surrounds the end of the electrode, the arc, and the weld zone with an inert monatomic gas. Current densities on the small-diameter wires are very high, resulting in correspondingly high burn-off rates, and the deposition rate is rapid.

A typical application of this process reduced the time for a mass-production, assembly-line welding operation from 1 1/2 minutes, using two operators, to 8 seconds, with one operator working at a normal pace. The job consisted of joining aluminum window-sash hinges, each requiring two 1/4- by 1 1/2-inch welds.

In another case, the welding time for a large aluminum ink container, Fig. 1, was cut from 280 to 48 man-hours. Fig. 2 illustrates the joining of the top to the sides after completing the butt-welding of the sides.

The heading illustration shows the application of this process to the welding of aluminum awning brackets, such as shown in Fig. 3, at the plant of the Mid-States Ornamental Iron Works, Kansas City, Mo. In this high-production job, each bracket required 24 inches of 1/4-inch fillet welding. Using 1/16-inch diameter 43S wire at a feed rate of 210 inches per minute with 220 amperes reversed polarity direct current, the welding operation required less than 2 minutes per bracket, including incidental set-up time. High-purity helium was employed as the gas shield at a flow rate of 35 cubic feet per hour.

The fundamental difficulty in most cases of aluminum welding is a serious tendency toward porosity. This almost universal problem with the aluminum alloys is usually thought to arise from hydrogen being entrapped or dissolved in the molten metal, which has a high capacity for dissolved hydrogen. Upon freezing, however, aluminum loses this capacity to hold hydrogen in solution, and it is rejected as the metal solidifies.

Unless the metal freezes from the bottom up, so that the gas can pass through the liquid metal and escape at the surface of the molten pool, it forms voids, varying from sub-microscopic pinholes to easily visible bubbles, and for some purposes these voids render the weld too weak or brittle for safe use.

In many other cases, however, where strength requirements are more moderate, and where porosity does not seriously affect the appearance of the weld, the problem is not considered important, and a bead of satisfactory size and shape, with good penetration, is all that is required, so that moderate porosity is permissible.

When porosity-free welds are required, however, it is essential to get rid of any and all possible sources of free hydrogen in the weld area. Such sources, in Aircomatic welding, consist of the wire, the baseplate, and the weld atmosphere (or shielding gas). The two troublesome hydrogen sources, in the main, are water vapor adsorbed in the oxide films on the wire and work,

Hard-to-Weld Metals at Production Rates

By S. D. BAUMER
Manager, Technical Sales Department
Air Reduction Sales Co.

and hydrocarbon dirt, either on the metal or in the shielding gas. As present standard welding grades of argon and high-purity helium are practically free of such impurities, the problem is one of eliminating contamination carried by the aluminum itself.

While the base metal represents a relatively small proportion of the total metal surface involved, it can carry a serious amount of hydrogen releasing materials, and so should be cleaned as much as practicable in the weld area.

The wire, which is the chief source of trouble, is now being specially processed to remove all grease and dirt and to strip the oxide film as much as possible. It is delivered to the user protected against further contamination, and is suitably wound on disposable reels designed for use on Aircomatic welding equipment.

With clean wire, clean base metal, and high-purity inert gas, and with the further aid of simple welding techniques that help to slow the freezing of the weld pool, "X-ray quality" welds can be consistently produced in the horizontal and flat positions in aluminum. Vertical and overhead aluminum welds are a more difficult problem because of the inherent necessity of a fast freeze action for welding in these positions, which tends to trap most of the porosity causing gas present in the weld. Therefore, while sound welds can be achieved in these positions at times, it is recommended that welding should be done in the flat or horizontal position when peak quality is essential.

The need for "X-ray quality" soundness in an aluminum weld must be considered in the light of the application for which the weld is being

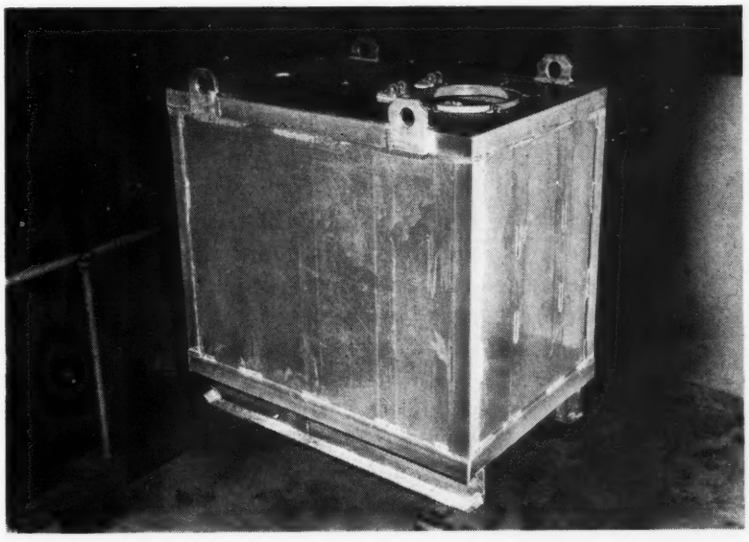


Fig. 1. Welding time for fabricating aluminum ink containers of the type shown was reduced from 280 to 48 man-hours by the use of the "Aircomatic" process

Fig. 2. An overhead fillet weld is made in the interior of the aluminum container illustrated in Fig. 1 to join the top to the welded sides

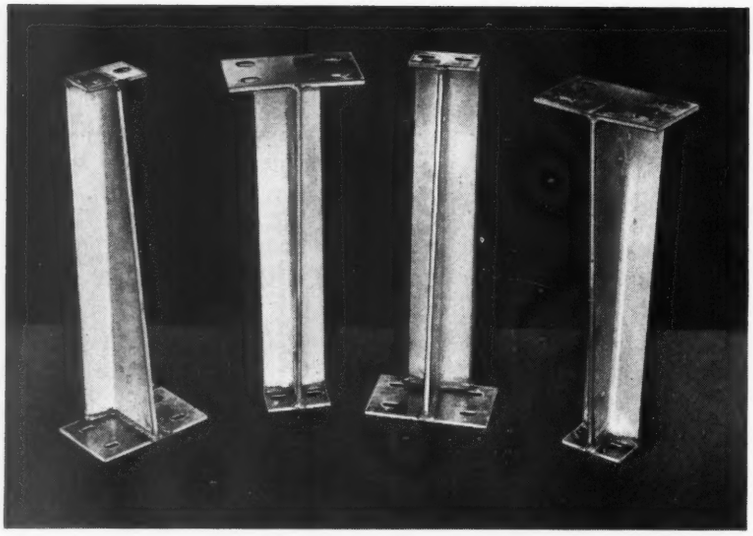


Fig. 3. Aluminum awning brackets, each of which requires a total of 24 inches of 1/4-inch fillet welding and is completed on a simple rotating fixture in two minutes

made. Many—most, indeed—of the aluminum weldments in production today do not need to be made to such a high standard. The physical and mechanical properties required by the product should be the primary yardstick, and from many viewpoints, this will make "X-ray quality" an unduly high standard.

The comparative tensile strengths of typical well executed Aircomatic welds in aluminum are shown in Table 1. The most popular of the weldable aluminum alloys—2S, 3S, and 61S—are all generally recommended for Aircomatic welding. Welds in 2S and 3S aluminum with 2S wire develop approximately the full strength of the annealed base metal. Welds in 61S plate with 43S wire develop a good proportion of the physical properties of the annealed base metal and are susceptible to treatment for greater strength.

Table 2 shows a general outline of welding procedures used with this process. Wires of 3/64, 1/16, and 3/32 inch diameter are used, depending upon the kind of job and upon such factors as plate thickness, speed, etc. Currents range from 160 to 350 amperes, while practical manual welding speeds range from a few inches to 24 inches a minute, and at times are only limited by the operator's ability to move with the speed of the operation.

In addition to the savings in costs made possible on mass production work, the automatic inert-gas shielded metal arc process is economical on jobs requiring large quantities of metal to be deposited rather than the welding of many parts. Such a case is the reclamation of railroad Diesel-engine pistons, which has become an increasingly important operation. With deposition rates running as high as 10 pounds per hour of arc time, the automatic head welds average pistons in two to two and one-half hours when the worn grooves are completely machined away, and in less time when the machining is not so extensive.

Pistons repaired in this way are entirely satisfactory. The deposit is sound—in fact, the soundness of the deposited weld metal is superior to that of the original casting. In the case illustrated in Fig. 4, the worn grooves were machined out to leave a single space 3 1/8 inches high by 1/2 inch deep, and a 1/8 by 1/2 inch step was cut in the worn top edge of the piston at the right. After being preheated to 250 degrees F., the piston was welded to fill the groove

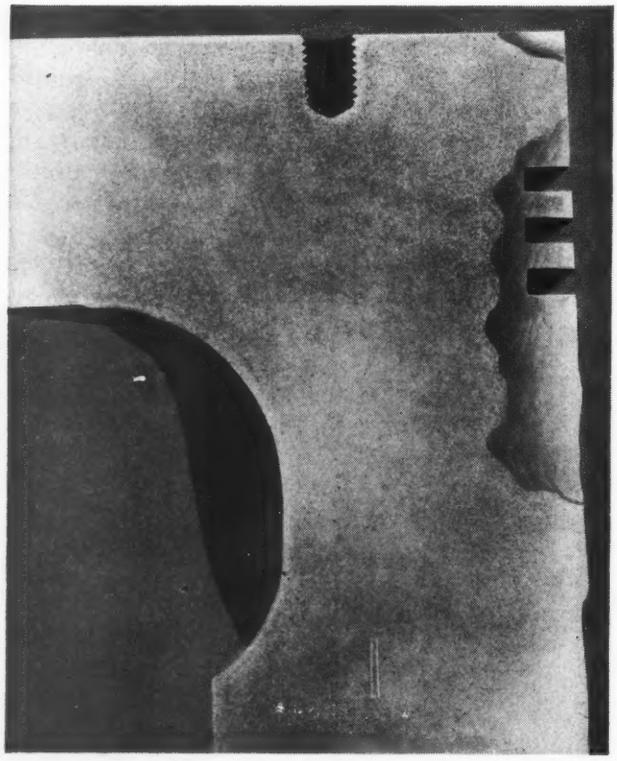


Fig. 4. Cross-section of a welded railroad Diesel-engine piston showing remachined grooves in weld metal and the machined corner at the top right that was rebuilt by welding

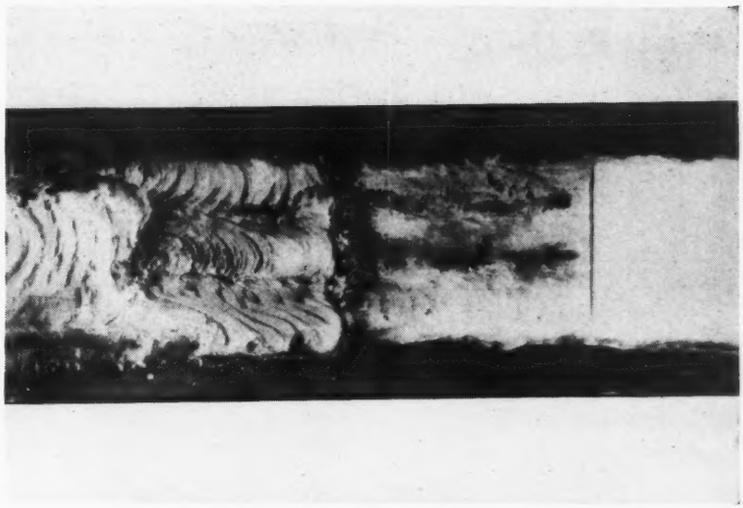


Fig. 5. Typical example of an aluminum-bronze overlay welded to steel. Note smooth beads at the left and soundness of the metal at the machined surface on the right

space in thirty passes, using 330- to 420-ampere, 25- to 35-volt current and 1/8-inch diameter 43S wire. The step at the top was filled by a manual operation in 7 1/2 minutes using 210-ampere current. Grooves were then machined in the filled space as shown.

The weldability of aluminum bronze by the Aircomatic process is excellent, and the development of a rapid, reliable tool for depositing this material shows promise of opening up a considerable range of new uses for aluminum-bronze alloys. Although possessing interesting and highly valuable properties, these alloys have suffered somewhat from unreliable results in stick electrode deposition, and have represented a cost problem with other methods. Aircomatic welding not only makes joining or overlaying with aluminum bronze economical but also delivers a deposit of high quality.

Table 1. Tensile Strength of Typical Aircomatic Welds in Aluminum

Material and Thickness (Inches)	Type of Joint and Number of Passes Required	Tensile Strength, Pounds per Square Inch
3S–3/16	Square butt One pass	14,800
2S–3/8	Square butt One pass each side	13,000
61S–3/8	Square butt One pass each side	As-welded, 28,000 Heat-treated, 44,000
61S–3/4	30-degree vee Two passes	As-welded, 25,000 Heat-treated, 42,000
3S–1	90-degree double vee, 1/4-inch Nose Four passes	18,000

This alloy, when used with the Aircomatic process, produces a smooth, sound deposit with a bright surface, as seen in Fig. 5, and has an excellent bond to the base metal when used as an overlay for wear resistance or as a joining alloy for dissimilar metals or for such materials as cast iron.

It also produces a completely satisfactory joint with base materials of similar analysis. Either the standard alloy of 89 to 90 per cent copper, 8 per cent aluminum, 1 per cent iron, and a total of 1 per cent other constituents, or the simpler alloy of about 8 per cent aluminum and 92 per cent copper can be used, depending upon whether or not the higher properties of the standard alloy are required. With either material, this welding process produces a deposit possessing the full properties inherent in the alloy selected at rapid rates of deposition.

Table 2. Procedure Guide—Aircomatic Manual Welding of Aluminum

Plate Thickness, Inches	Welding Position	Wire Diameter, Inches	Shielding Gas Flow, Cubic Feet per hour		Reverse Polarity Direct-Current Range, Amperes
			Argon	Helium	
3/16 to 1/2	Flat and Horizontal	1/16	20 to 40	30 to 50	160 to 250
3/8 up	Flat and Horizontal	3/32	....	50 to 75	225 to 350
3/16 up	Vertical and Overhead	1/16	20 to 40	30 to 50	140 to 225

Welding procedures are highly flexible, and satisfactory results are obtained throughout a wide range of settings. The basic procedure

Fig. 6. Compressor cases welded with aluminum bronze by the Aircomatic process. At left are seen the welded cases, and at right the unwelded parts

employs argon as the shielding gas, reversed-polarity, 50- to 375-ampere direct current, and filler wire feed speeds ranging from 50 to 350 inches per minute. A high degree of control over arc, depth of penetration, and degree of dilution is obtainable when welding these bronzes with the Aircomatic process, and the operation is readily adaptable to individual requirements.

An application of aluminum-bronze welding is illustrated in Fig. 6. In this case, the circumferential welds made in joining a 3/16-inch thick shell to 1/4-inch thick mild-steel heads in a compressor case, 10 inches high by 6 1/2 inches in diameter, are produced in a rotating fixture with the manual Aircomatic gun, using 1/16-inch diameter aluminum-bronze wire. The joining of both top and bottom heads was completed in about 25 seconds, using 250-ampere current, a flow of 40 cubic feet per hour of argon, and depositing wire at the rate of about 10 pounds per hour. After welding, these units withstood a hydrostatic test of 500 pounds per square inch without failure or leakage. Deposit quality was excellent.

Silicon bronze, which is also readily weldable at excellent speeds with this process, produces highly satisfactory results under X-ray, metal-

Table 3. Mechanical Properties of Type 304 Stainless-Steel Aircomatic Welds

Mechanical Properties	As Welded	Annealed
Tensile Strength, Pounds per Square Inch	86,000 to 90,200	80,000 to 78,400
Yield Strength, 0.2 Offset, Pounds per Square Inch	52,500 to 57,000	38,200 to 37,300
Elongation, Per Cent in 2 Inches	52.5 to 57.0	37.3 to 38.2
Reduction of Area, Per Cent	47.0 to 59.4	62.5
Rockwell B Hardness	87.0 to 83.0	78.6 to 80.0

Table 4. Data for Welding Stainless Steels in All Positions with the Aircomatic Process

Sheet or Plate Thickness, Inch*	Welding Position†	Filler Wire Diameter, Inch	Current, Amperes	Wire Feed, Inches per Minute	Shielding Gas	Gas Flow, Cubic Feet per Hour
1/16	F, H, VD	0.035	110 to 140	230 to 260	Helium	20 to 30
1/8 to 3/16	F, H, OH, VD	0.035	110 to 140	230 to 260	Helium	20 to 30
1/4 to 1	F, H, OH, VD	0.035	170 to 190	330 to 360	Argon	20 to 30
1/2 to 1	V	0.045	140 to 180	160 to 200	Argon	20 to 30
3/16 to 3/8	F, H	0.045	190 to 310	210 to 440	Argon	30 to 40
7/16 and up	OH	0.045	190 to 310	210 to 440	Argon	30 to 40

* All joint types — butt, lap, and fillet
† F, flat; H, horizontal; OH, overhead; VD, vertical down; V, vertical up

lographic, and mechanical tests. This material, when welded in sufficient volume to warrant its application, is ideally suited for welding by the process described.

The austenitic chrome-nickel stainless steels can be successfully welded by the Aircomatic process in all positions without preheat or other special treatments. Of course, the general limitation on this class of alloy applies; materials that would be made corrosion sensitive by stick-electrode welding or torch-welding will also be affected in the same way (though perhaps to lesser degree) by this process. In other words, the same principles that govern all other stainless-steel welding must be applied when using this process.

As with coated electrodes, filler wire analyses must be controlled to prevent cracking, but the wire does not require any provision for loss of alloy elements in the arc. With existing materials and equipment, thicknesses of 1/8 inch and up can readily be welded; thinner materials can be handled with special care.

Stainless-steel welds made with this process have excellent properties. Table 3 shows typical mechanical properties produced in Type 304 all-weld metal. Tensile and yield strengths, as welded, are higher than those of the annealed base metal. Ductility is high for both as-welded and annealed specimens. Face and root-bend specimens pass a 180-degree bend test consistently, and in general, the mechanical properties of stainless-steel welds with this process are equal to or slightly superior to those obtained with conventional coated electrodes.

With proper arc and filler wire, a trained operator can produce welds in all positions that meet the requirements of existing codes for pressure vessel welding. Data on Aircomatic welding procedures for stainless steel is given in Table 4.

Carpet-machinery rolls, such as the one shown in Fig. 7, are about 13 feet long and 2 feet in diameter. They must carry 50 pounds of steam pressure, and they consist of a stainless-steel shell, 0.093 inch thick, welded to two mild-steel

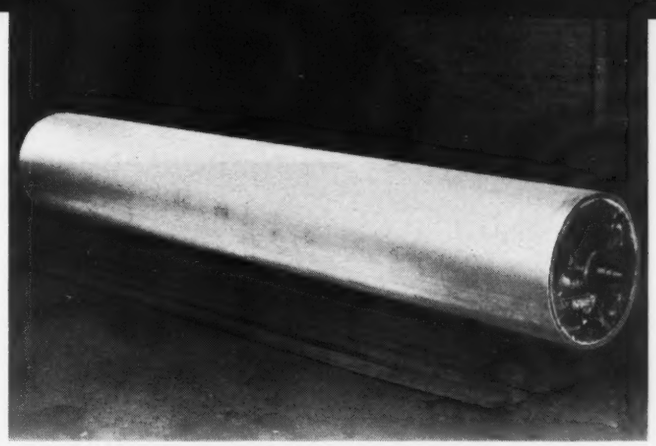


Fig. 7. (Top) Finished carpet-machinery roller with stainless-steel shell and mild-steel heads, produced by Heliwelding the shell and Aircomatic welding the head joints

Fig. 8. (Center) Welding one head of roller shown in Fig. 7 in flat position. Roller is made in halves, permitting set up for "down-hand" welding of one head. Second head is welded in vertical position after girth seam in shell has been welded

Fig. 9. (Bottom) Detail of head-to-shell joint in roller shown in Fig. 7, illustrating narrow, deep groove created by bevel in head

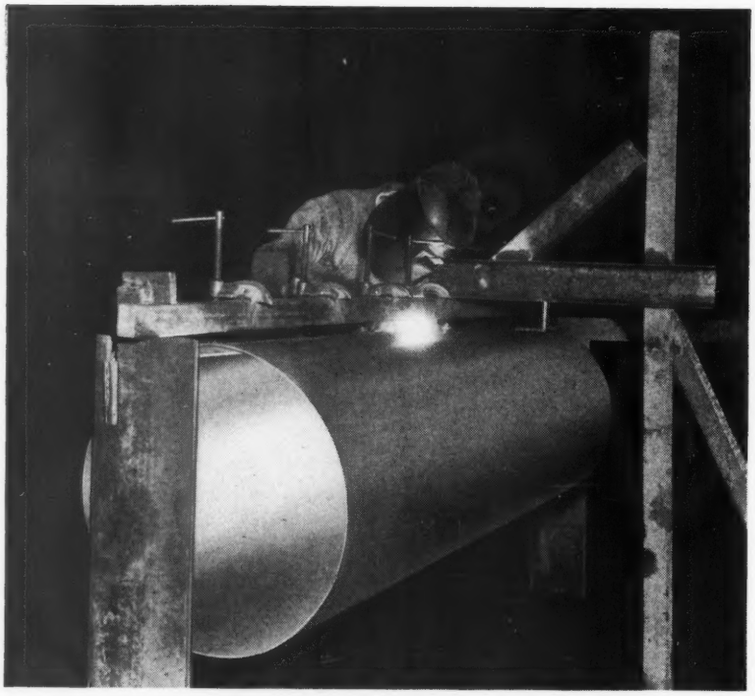


Fig. 10. Heliwelding lengthwise and girth seams of thin stainless-steel shells prior to using Aircomatic process for welding mild-steel heads to shell

heads. The welding operation is illustrated in Fig. 8. The heads are 1 1/4 inches thick—far in excess of normal requirements—and the joint formed by the 30-degree bevel on the edge of the head and the end of the shell, Fig. 9, is an extremely difficult welding job.

With stick electrodes, it required about 16 pounds of rods, and including cleaning of the weld, approximately six man-hours was needed to weld each head. Great care was necessary to minimize "burn through" on the thin stainless-steel section. With Aircomatic welding, 6 1/2 pounds of stainless-steel wire, 0.035 inch in diameter was used, and the job was completed in 1 1/2 hours welding time. Using a wire feed speed of over 300 inches per minute, from 200- to 300-ampere current, and 30 cubic feet per hour of argon, material costs for the job were about equal. The total saving with the latter process was between $14 and $18 per roll.

An interesting sidelight on this job is the use of Heliwelding in combination with Aircomatic welding. The shells are seam- and girth-welded by the Heliwelding process, Fig. 10, without filler metal, in order to minimize finishing operations, while the ends, Fig. 9, requiring much filler metal, are joined efficiently with the inert-gas shielded metal arc-welding process.

Aluminum Sheet and Plate Nomenclature Approved

TO clarify the designation of aluminum sheet and plate, the Sheet Division of the Aluminum Association has adopted the following standard nomenclature for these products:

(1) *Plate* is a solid section rolled to a thickness of 0.250 inch and heavier, in rectangular form with either sheared or sawed edges.

(2) *Sheet* is a solid section rolled to a thickness range of 0.006 inch to 0.249 inch, inclusive, supplied with sheared, slit, or sawed edges.

a. *Flat Sheet* is furnished in rectangular form with sheared, slit, or sawed edges, which may be flattened by any standard method.
b. *Coiled Sheet* is furnished in rolls (coils) with slit edges.

Heretofore, the terms "strip" and "coiled sheet" were applied interchangeably to the same product, but the new nomenclature officially recognizes the latter, more descriptive term.

The definitions were formulated by a Sheet Division committee comprised of representatives of the Aluminum Co. of America, Sheet Aluminum Corporation, Kaiser Aluminum and Chemical Corporation, Reynolds Metals Co., Revere Copper and Brass, Inc., Fairmont Aluminum Co., and United Smelting and Aluminum Co.

* * *

In 1901, the largest American steel company produced 66 per cent of all the steel made in America; today it produces only 33 per cent.

Machining Aircraft Turbine Blades

Second and Concluding Installment of an Article Describing Methods and Equipment Used by the Bristol Aeroplane Co., Ltd., England, in Machining Aircraft Turbine Blades from Nimonic Alloy

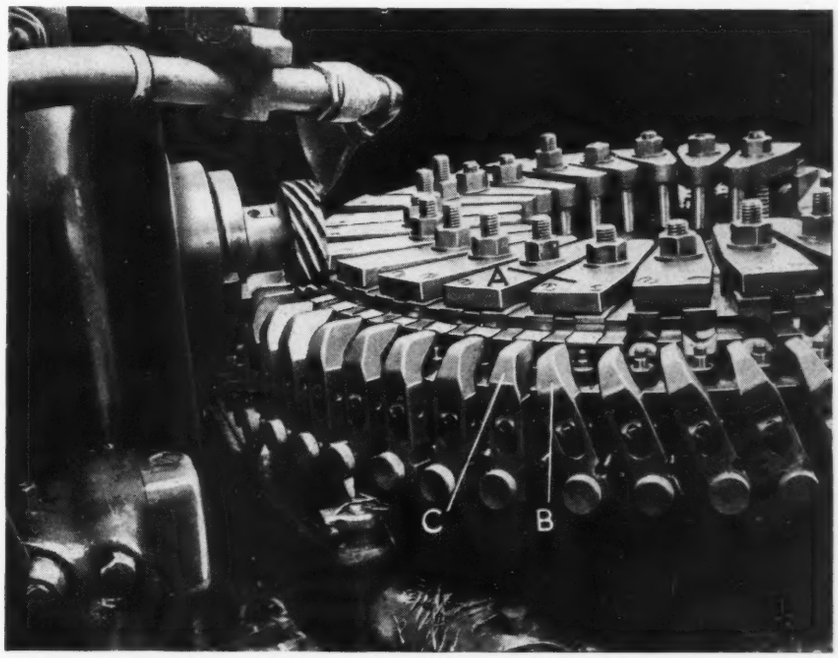


Fig. 1. Root ends of aircraft turbine blades are rough-formed in a continuous milling operation prior to grinding the "Christmas tree" forms

PRODUCTION of Nimonic alloy turbine blades for Bristol propeller-turbine aircraft engines formed the subject of an article published in July MACHINERY. Requirements for successful machining of Nimonic alloys were considered, and the initial operations on the blades were described. Further machining operations will be described here.

After milling the concave form on the blade with the modified Snyder machine as described in the first installment, an additional operation is required to square up the platform face of the blade. This corresponds to the platform squaring operation performed after grinding the external profile. The internal squaring operation is necessitated by the fact that, on the Snyder machine, the cutter axis is inclined to that of the blade root to produce the required twist on the concave surface.

A cam milling machine has been specially adapted for the internal platform milling operation by the provision of a Geneva motion between the control cam and the work-head. The form required is not generated, the action of the cam and the consequent rocking of the work-head carriage causing the Woodruff cutter to sink into the work to the necessary depth without any profiling action. The Geneva mechanism insures that the work-holding fixture does not rotate while the cut is being taken.

After indexing, the work fixture is fed toward the cutter, the depth of cut being controlled by the cam profile. The cam rotates continuously, and the work is withdrawn when the required depth of cut has been reached. The Geneva motion then causes the work-holding fixture to index before the next cycle of operations commences.

After the profiling operations on the blade have been completed, the root is machined. Three grinding operations were formerly needed to produce the dovetail or "Christmas tree" form of the root. Now, however, the work is completed in two stages, the form being ground after a rough-milling operation, during which as much excess metal as possible is removed.

Rough-Milling the "Christmas Tree" Form of the Root

The rough-milling operation, which brings the blade root to the form of a truncated vee, is performed on a Cincinnati No. 3 horizontal milling machine, the table of which carries a multi-station work-holding fixture, as shown in Fig. 1. The fixture rotates continuously, carrying the blade roots under the spiral form-cutter.

Matrices locate the profiled blade faces in the fixture, which is designed to permit both sides of the roots to be milled. Each of the clamps *A*

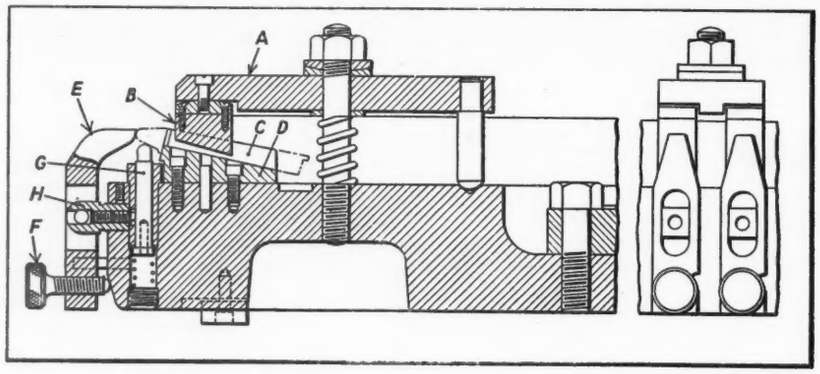


Fig. 2. Part-sectional drawing showing the method of locating and holding the turbine blades for the root-milling operation seen in Fig. 1

secures two blades, one being positioned with the concave form upward and the other with the concave form downward, a male and a female matrix being arranged beneath each clamp. At the loading station, a blade machined on one of its root faces is removed from beneath each clamp and replaced by a new work-piece, while the partly machined blade is transferred to the adjoining station, from which a completely rough-milled blade has been removed.

The clamps *A* carry pads of matrix form, alternately concave and convex to suit the blades, which are supported by the lower locating matrices. As the pads are required to exert clamping pressure at the root ends of the blades, they are shorter than the locating matrices, and to insure a self-compensating action, they are slightly rounded on the surfaces that are engaged by the clamps and are secured by shouldered screws in clearance holes.

A sectional view through part of the clamping fixture is shown in Fig. 2. Here one of the main clamps is seen at *A*, with its pad at *B* holding the blade *C* against the locating matrix *D*. Endwise pressure is applied to the root of the blade to insure that the platform face is securely supported against the edge of the locating matrix. This endwise pressure is provided by the bar clamp *E* at each blade position. A screw *F* at the lower end of the bar clamps provides the gripping pressure.

Support for the blade root against the load exerted by the milling cutter is afforded by the vertical spring-loaded plunger *G*, which is automatically locked in the required position. It is necessary that this plunger be self-adjusting vertically, since it engages a surface on the blade root which may or may not have been machined, and the arrangement is such that the action of turning the bar clamp *E* locks the plunger *G* in position.

The clamp *E* is carried by a trunnion in an eye-bolt member *H*, which is screwed into the body of the fixture and serves to secure the plunger *G*. In the threaded bore of member *H* there are two set-screws, one of which engages the plunger member to clamp it, while the other locks the first in position. A means of adjusting the clamping position is thus provided. Movement of the bar clamp from the loading position, as shown at *B* in Fig. 1, to the clamping position shown at *C*, turns the eye-bolt member and locks the vertical plunger.

In loading, after a blade has been placed on the locating matrix, the main clamp carrying the self-adjusting pad is tightened, although not sufficiently to prevent axial movement of the blade. This clamping action causes the plunger to be depressed to the appropriate position for the particular blade, and the bar clamp is then turned to the operating position and locked by means of its knurled screw, thus holding the platform face of the blade against the locating

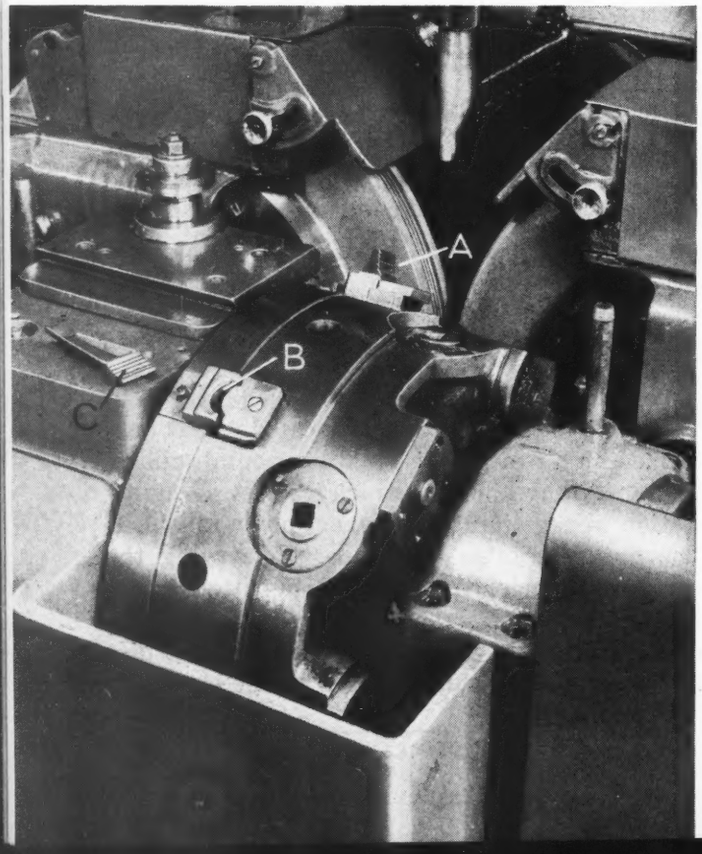


Fig. 3. "Christmas tree" forms are ground in roots of the turbine blades on a special centerless type of grinding machine with formed abrasive wheels

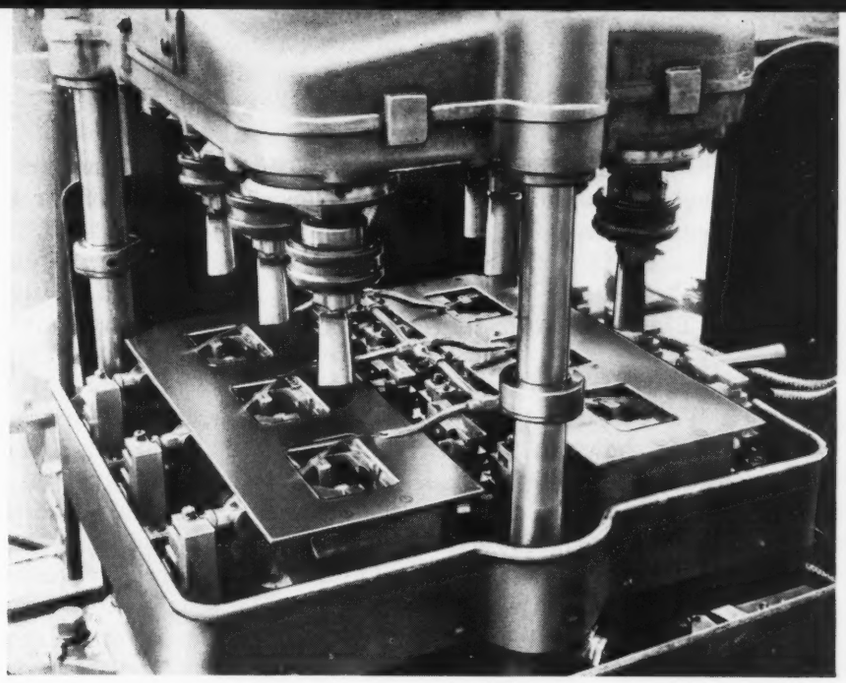


Fig. 4. A surface finish of from 1½ to 2 micro-inches is obtained simultaneously on both concave and convex profiles of six turbine blades in this honing operation

matrix. The turning movement also locks the vertical plunger, as described, the arrangement being such that, at the point of locking, the bar clamp is correctly positioned. Finally the main clamp is fully tightened.

The root milling operation is carried out at a cutting speed of 34 feet per minute, and the fixture rotates once every 36 minutes. An 18 per cent tungsten, 5 per cent cobalt, high-speed steel cutter having a helix angle of 45 degrees is employed. The coolant used for the operation is Solcut soluble cutting oil.

Before the serrations are ground on the roots, the blades are age-hardened, the work being held at a temperature of about 1292 degrees F. for sixteen hours and then cooled in air.

Equipment Used for Grinding the "Christmas Tree" Root Form

For the "Christmas tree" root-form grinding operation, a battery of special machines developed by the Coventry Gauge & Tool Co., Ltd., in collaboration with the Bristol Aeroplane Co. is installed. A close-up view of one of these machines is seen in Fig. 3. The two formed grinding wheels are mounted on horizontal spindles which are parallel to each other. The wheels rotate in opposite directions, and the blade roots are fed vertically upward between them, the forms of the crushed wheels being thus reproduced on the two root flanks.

A six-position work-holding fixture is mounted in bearings which are at right angles to those of the grinding wheels, as shown. The grinding wheel spindles may be moved toward or away from each other to compensate for wheel wear, and a crosswise adjustment is also provided to permit aligning the serrations on the two wheels if necessary.

The blades are located from the formed surfaces by matrices, endwise positioning being obtained from the platform faces. The moving matrix or clamping pad is operated by a key to clamp the work to the fixed locating surface. In operation, the work fixture feeds slowly upward to pass the blade root between the two wheels, and indexes after the cut has been taken. During the indexing, the fixture is lowered to the starting position again. Indexing is not completed until the starting position has almost been reached. The illustration shows a ground blade at *A* and the matrices at *B* in the open position ready to receive a new work-piece to replace the blade *C*, which has just been removed.

Loading and unloading are performed during the operation. Wheels of 180-grit aluminum-oxide abrasive with vitrified binder are used, and the lubricant is a thread grinding oil.

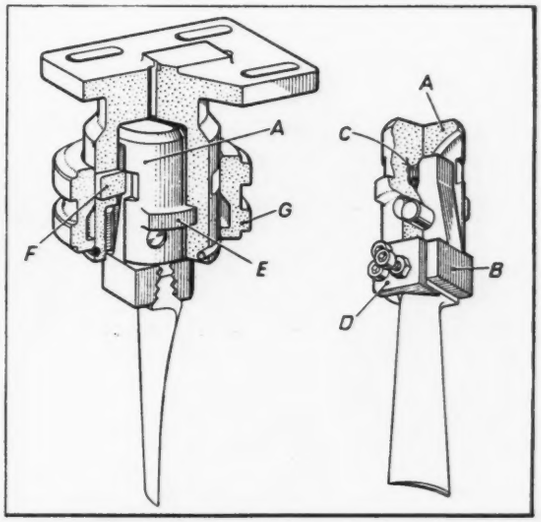


Fig. 5. Part-sectional drawings showing (left) the blade-holder positioned in the chuck on the honing machine seen in Fig. 4, and (right) detail of the blade-holder

For the inspection of the serrations, pins 0.055 inch in diameter are used. The tolerance allowed for the dimensions over pins placed in serrations on opposite flanks is 0.0005 inch.

Honing the Blades on Multiple-Head Machines

Blade honing is performed on specially adapted Kitchen & Wade geared type honing machines, one of which is shown in Fig. 4. The machines are equipped with multiple heads designed to accommodate six blades at once. The fixture carrying the honing arms is supported on a pneumatic ram, and can be lowered to facilitate loading and unloading of the work. The equipment enables a finish of from 1 1/2 to 2 micro-inches to be obtained simultaneously on both sides of six blades.

During the operation, the blades are held vertically, as shown, being gripped in special chucks, and diamond-impregnated honing pads are held in contact with them under pressure of pneumatic plungers. The blades are turned backward and forward, describing an accurate path between the honing pads, and are simultaneously reciprocated vertically, so that the full length of the surfaces is covered.

The driving head is guided by three vertical pillars, which also insure that the head and the fixture are maintained in alignment. It imparts an oscillatory motion of 105 to 140 degrees to the chucks carrying the blades. The bolt-holes in the chuck baseplates are elongated, as shown in Fig. 5, to permit "offsetting" to suit the profile radius of any particular blade, and also to accommodate blades of different widths.

The blades are secured in holders which grip the serrations of the roots. Each holder has a body *A* of cylindrical form with a serrated register for one side of the blade, the opposite side of the cylinder being slotted to accommodate a pivoted jaw *B*. This jaw is also serrated at its lower end to engage the opposite side of the blade root. A pivot-pin holds the jaw in position, and a tightening screw *C* is provided. Guide block *D* prevents the blade from being placed incorrectly in the blade-holder.

There are two lugs on the blade-holder, one of which is indicated at *E*. These lugs are of different widths, and the chuck body has two slots, also of different widths, which engage the corresponding lugs, so that the holder cannot be incorrectly loaded into the chuck. The driving segments *F* lock the holder in position in the chuck, and a collar *G* is provided for quick engagement and release.

While the honing machine is in operation on one set of blades, a duplicate set of blade-holders may be loaded and the blades clamped in position. The chucks can thus be reloaded when required, with the minimum of delay.

The honing fixture carries six sets of hones, each comprising three pairs of honing arms set one below the other. Fig. 6 shows a blade-holder and chuck at the left, and a set of honing arms at the right. Three of the latter are arranged for honing the concave surface of the blades, and the other three the convex profile. The arms are carried in stepped brackets, designed for ease of set-up and adjustment.

A part-sectional view of one of the honing arms is seen in Fig. 7. It is pivoted at one end, and a limited twisting movement of the shoe is permitted, the latter being mounted at the end of a pin which passes through the rectangular swivel arm. The diamond-impregnated honing pad, which is set at a slight angle, is held at the end of the arm, a set-screw being provided to

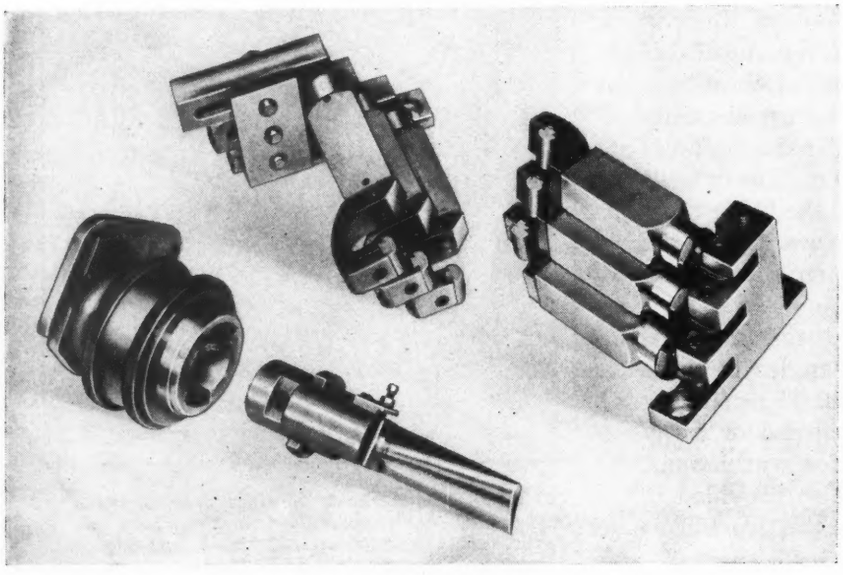


Fig. 6. Chuck and turbine blade-holder (left) and set of six honing arms (right) used on the honing machine seen in Fig. 4. The honing fixture carries six sets of hones

apply the locking pressure, as shown. The rectangular swivel arms rest one against the other in the arm assembly.

Pneumatic Means for Actuating Honing Arms

Air pressure is used to keep the honing pads in contact with the blades. The air circuit is shown diagrammatically in Fig. 8. Compressed air from the line *A* passes through a reducing valve *B* to a three-way control valve *C*. The valve *B* reduces the pressure of the air to 60 pounds per square inch. From the control valve *C*, the air passes to pressure plungers *D* or *E*, housed in the plunger blocks *F*. The plungers engage the honing arms *G*, pivoted in the brackets *H*, and when the air pressure is applied to the plungers *D*, the honing arms move inward and the honing pads engage the work. On the other hand, when the plungers *E* are operated, the honing arms are retracted to the loading position. The arrows indicate the flow of air to the plungers *D*.

In setting up the machine, the radius of the arc through which the work is oscillated may be altered by adjusting the position of the chucks, as previously described. The angular extent of the arc may be varied by the use of an adjustable throw pin in the head, and the angular position of the arc can be also varied as required. Usually a setting is employed which insures minimum deflection of the honing pads and arms, as the blades reciprocate between them, the path chosen being an arc representing the mean of the concave and convex profiles.

The length of the arc and its angular position with relation to the honing pads is of great importance, for if the pads passed beyond the leading or the trailing edges of the blades, knife edges would be formed. Length of stroke is also important, and is set so that the bottom edge of the lowermost hone is 1/8 inch below the bottom of the blade when at the top of the stroke, and the top hone just clears the shoulder radius of the blade at the bottom of the stroke.

The sequence of operations is as follows: The loaded holders are secured in the six chucks of the driving head, with the table lowered and the hones in the open position. The table is then raised by a valve-controlled lever until the movement is arrested by the stops on the pillars.

Next, the honing pads are engaged with the blades, and the machine is started. The driving spindle speed is such that the blades are oscillated in their curved paths eighty times per minute, the vertical reciprocating speed being 60 strokes per minute. Rough-honing is continued, using a copious flow of coolant, for six

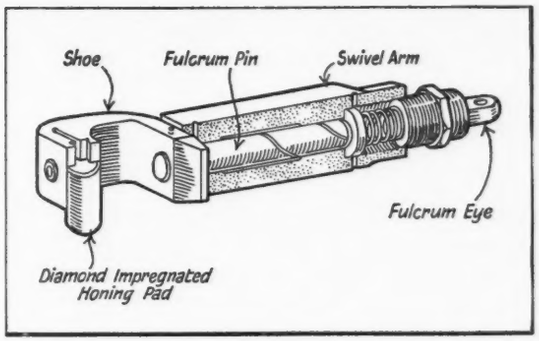


Fig. 7. Sectional view of a honing arm showing the diamond-impregnated honing pad in position on its shoe. The honing pad is set at a slight angle

or seven minutes until all previous machining marks have been removed.

The blades are then transferred to an adjoining machine for finishing. This is operated at the same speeds for five minutes, after which the rate of vertical reciprocation is reduced to 3 strokes per minute and honing is continued for another two minutes.

The coolant used is a mixture of 60 per cent lard oil and 40 per cent paraffin. Stones of 240 to 250 grit are employed for roughing and of 400 to 500 grit for finishing. These stones have diamond-impregnated radiused profiles of parabolic form. With one set of stones of this type, 700 blades can be roughed at each station and approximately 1400 can be finished.

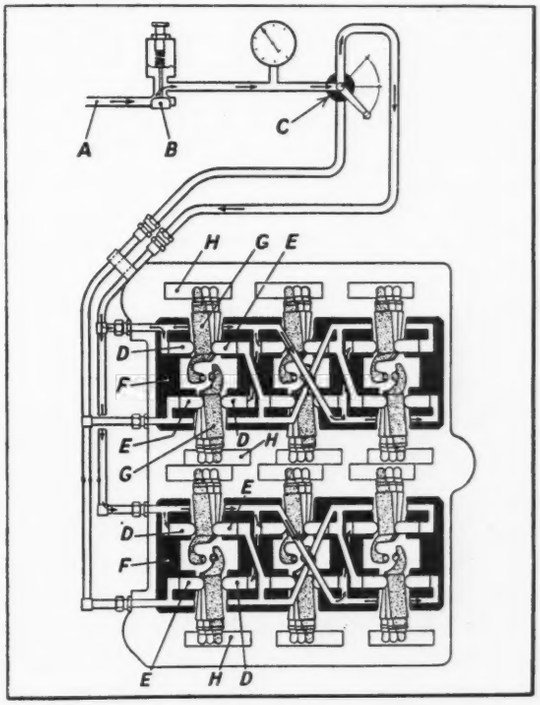


Fig. 8. Diagram of the air circuit employed to keep the honing pads in contact with the blades during honing and retract them during loading

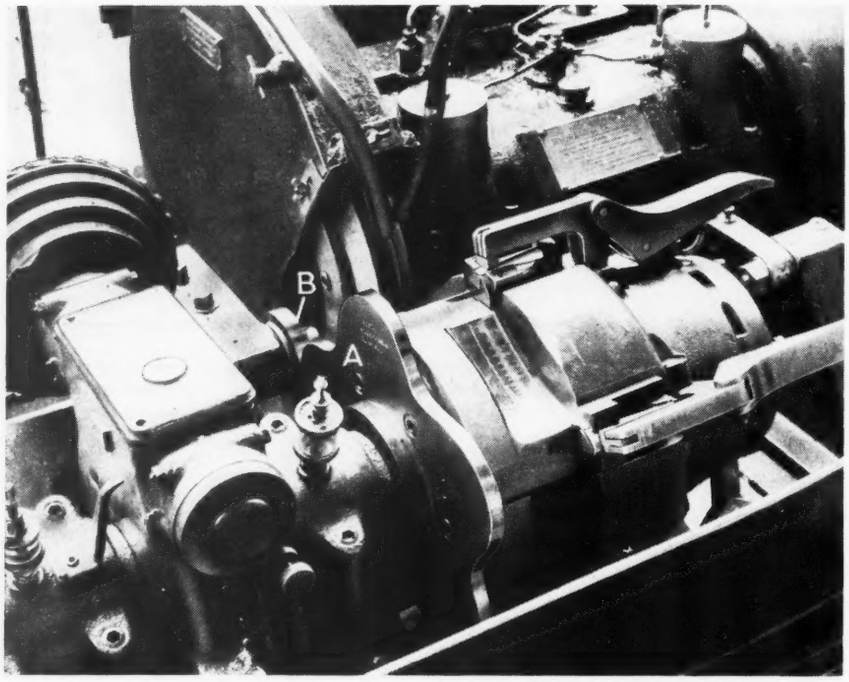


Fig. 9. Grinding machine employed in forming the tip relief on the turbine blades. The work is held in a cam-controlled continuously rotating fixture

Following honing, the blades are ground to width. During this operation, the blades are held in serrated slots in the steel bar of a fixture of rectangular box form, which is secured on the magnetic table of a surface grinding machine. The work is so located in the fixture that cuts can be taken on the sides of the blades, the leading and trailing edges being ground at separate settings.

Grinding machines having a cam-operated indexing fixture are employed for grinding the blades to length and forming the tip relief. The set-up for the latter operation is shown in Fig. 9. A five-station, horizontal, barrel type indexing fixture carries the work, and a cam *A* on the same spindle is held in engagement with the fixed roller *B*, the arrangement being very similar to that employed for grinding the platform on the convex side of the blade, as described in the previous article. The machine operates continuously, the fixture being loaded and unloaded while rotating.

Each blade is located concave face inward, a recessed block positioning the root end, while a formed pad engages the tip. The blade is located endwise from the root. Toggle-action clamps apply gripping pressure through the medium of pads specially formed to suit the convex surfaces of the blades.

Tip relief grinding, as described, follows the operation of grinding the blades to length. For length grinding, the same fixture is employed, but the cam is not used. Instead, the fixture barrel is rotated about a fixed axis so as to present the ends of the blades to the side of the grinding wheel. Here, again, the machine operates continuously.

Finally, the blades are polished to remove all tool marks, to blend the surfaces where necessary, and to finish the leading and trailing edges. These operations commence with stoning the edges, after which felt wheels, loaded with emery, are employed.

* * *

Motion Picture on Welding and Cutting

The International Acetylene Association, Inc., in cooperation with the United States Bureau of Mines, has produced a new sound-color motion picture on oxy-acetylene welding and cutting. The film explains what these processes are and what they will do. For example, it takes the audience right into the foundry and into the fabricating plant and shows how the oxy-acetylene processes are used to cut risers on castings, produce welded aluminum chair frames, and prepare structural steel shapes.

Copies of the film, which has a running time of twenty minutes, can be borrowed by vocational schools, engineering colleges, high school science and vocational classes, or business groups by addressing the supervising engineer, Graphic Services Section, Bureau of Mines Experiment Station, 4800 Forbes St., Pittsburgh 13, Pa. Those who desire to purchase copies of the film should write to the secretary, International Acetylene Association, Inc., 30 E. 42nd St., New York 17, N. Y.

Dye Method of Finding Surface Flaws in Metal Parts

THE presence of cracks in metal parts or other flaws too minute to be seen with a magnifying glass is readily detected by a new surface-quality inspection method developed by the Turbodyne Corporation, a subsidiary of Northrop Aircraft, Inc., Hawthorne, Calif. In this method, use is made of a brilliant red dye which "bleeds" in tell-tale scarlet lines against a white background from flaws in the part being inspected. The materials required in this process are available from the Dy-Chek Co., Division of Northrop Aircraft, Inc.

The first step in the application of the Dy-Chek process is to clean thoroughly the portion of the work to be inspected by applying a chemical solution which is contained in jar 1, Fig. 1. Then the red dye is applied, either by using a brush, as shown, or by dipping the part into the contents of jar 2. The dye may be sprayed on large pieces of work or on parts being handled on a production line.

After the dye has been permitted to dry, which requires a maximum of five minutes, the time depending upon the temperature of the room and the work, the dye is thoroughly removed from the work surface by applying a cleaning chemical from jar 3, as seen in Fig. 2. This solution is identical to that in jar 1, but

Fig. 1. Applying a brilliant red dye of high capillary action in using the Dy-Chek method to detect surface flaws in a crankshaft

Fig. 2. Using a chemical to thoroughly remove the red dye from all surfaces of the crankshaft is the third step in the Dy-Chek process

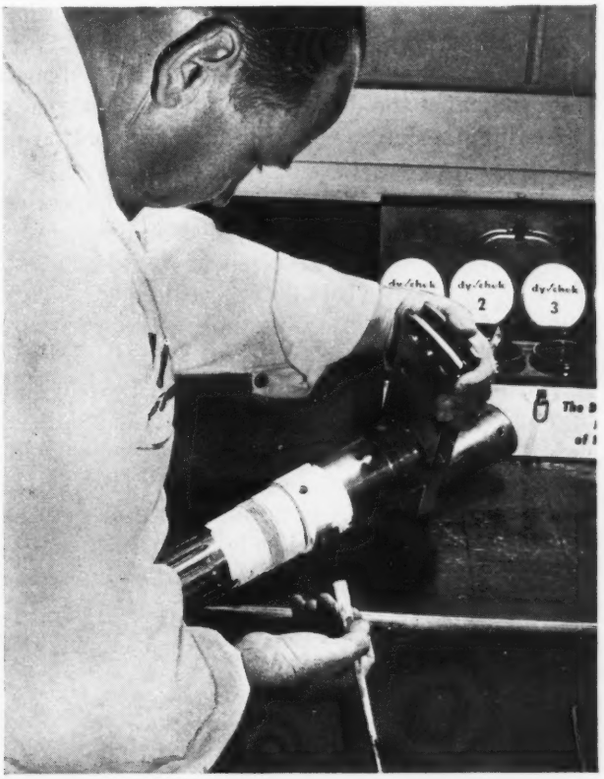


Fig. 3. Brushing on a white solution that dries quickly and causes any red dye in hidden cracks or other flaws to "bleed" readily

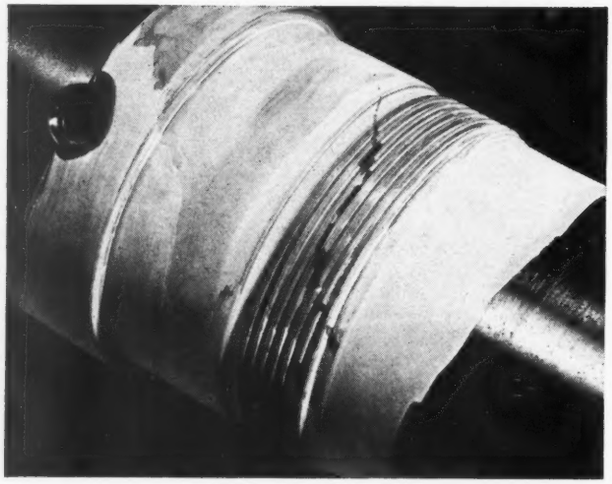


Fig. 4. The presence of red dye "bleeding" on the white developer indicates a distinct crack extending across the threads

separate jars are generally used to facilitate the successive steps of the process. Although this chemical removes all of the dye from the work surface, the dye remains in any cracks that may be present in the part.

The inspector now applies a white "developer" from the fourth jar, as shown in Fig. 3, which dries quickly. This chemical draws the red dye from the cracks or other flaws and, in the case of minute cracks, makes them immediately apparent in the form of a thin red line. If the crack is deep, the dye will "bleed" in a substantial amount and spread over the work surface adjacent to the flaw. The amount of "bleeding" indicates the depth of the flaw. The ready "bleeding" is due to the high capillary action of the dye.

Application of this dye-penetrant inspection method to a crankshaft revealed a distinct fissure that might have resulted in a serious accident. Fig. 4 shows this defect clearly. Although this surface inspection method was originally developed for use in checking the vitally important parts of gas-turbine engines, Dy-Chek is applicable in many industrial fields. It has been used not only in machine shops, foundries, welding departments, and forge shops, but also in automobile and aircraft maintenance shops and in such field installations as oil pipe lines. Parts of engines and other equipment can be inspected without disassembly. Weld inspection is expected to be an important application.

* * *

There were 1,660,000 businesses in the United States fifty years ago; today there are approximately 4,000,000, an average increase of more than 40,000 per year.

Carbide Tools Reduce Grinding Time on Small Parts

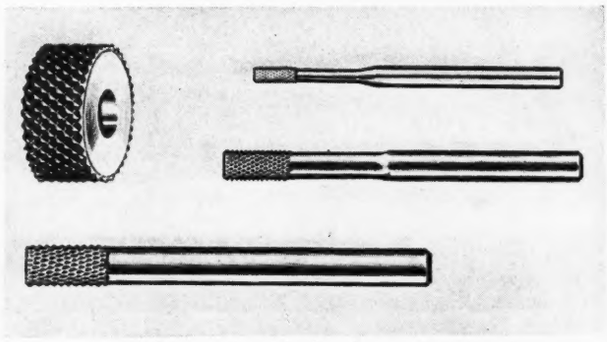
Typical examples of a group of carbide tools that are finding wide application for the internal and jig grinding of small holes in both soft and hardened steels (up to 65 Rockwell C), as well as in other metals, are shown in the accompanying illustration. Made of solid Carboloy cemented carbide, these tools are said to hold their size, produce a fine finish, and last longer than conventional grinding wheels.

In one shop, for instance, average production on the internal grinding of hardened steel collets (62 to 65 Rockwell C) was between ten and twenty units per wheel with abrasive type wheels. Sometimes only two or three collets could be ground per wheel. The time required to grind each collet averaged five minutes. Grinding tools made of Carboloy cemented carbide reduced the grinding time to two minutes per unit, and 218 collets were finished with one tool. The tool was then resharpened at small cost. Obviously, "down time" of the equipment was also reduced.

In another shop, it took five hours and six conventional grit wheels to grind holes in a particular drill jig. The same job was performed in seventeen minutes with a carbide grinding tool. Tolerance maintained for hole location was within 0.0002 inch.

* * *

The School of Industrial Arts in Puerto Rico, claimed to be the world's largest and best equipped vocational training school, has been set up to train technicians, mechanics, and construction men for the island's growing number of industries. Over $20,000,000 worth of equipment has been installed in fourteen buildings which cover 500,000 square feet of space. About 3500 students are enrolled in fifty different courses, while 22,000 applicants are awaiting admission.

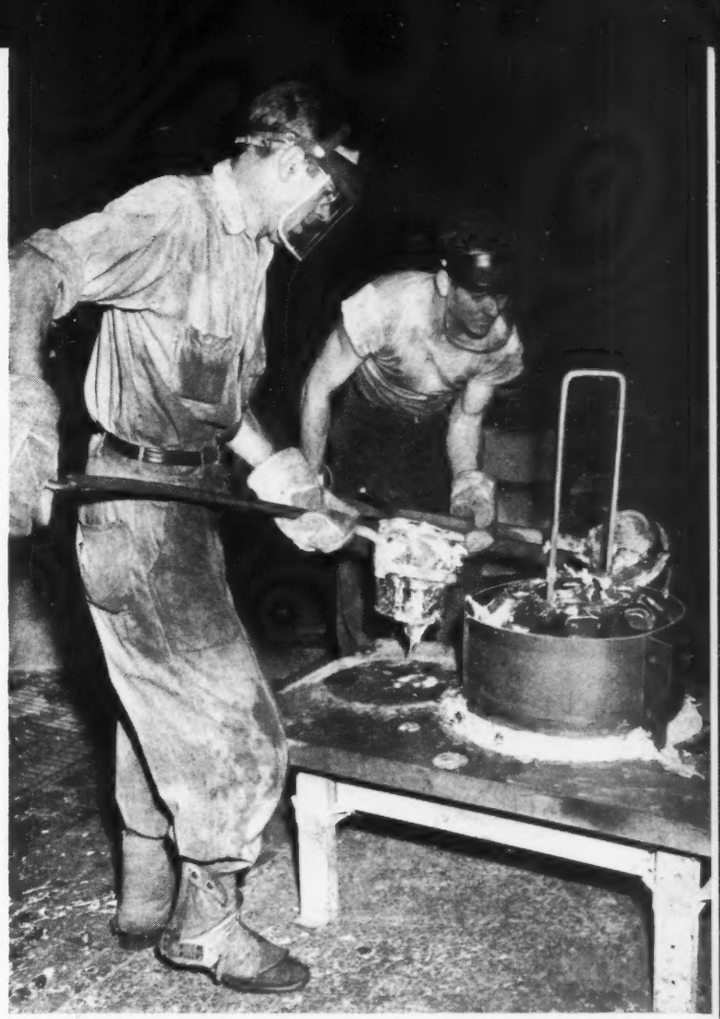


Various types of Carboloy tools used for grinding small holes in jigs and similar work

Bonding Aluminum to Ferrous Alloys

Details and Applications of the Heretofore Secret "Al-Fin" Process in which Pure Aluminum and Its Alloys can be Molecularly Bonded to Iron and Steel. Preselected Physical Properties of Both Metals are Combined in Such Bi-Metallic Components

By M. V. LITTLE
Al-Fin Division
Fairchild Engine and Airplane Corporation
Farmingdale, N. Y.



TO improve the air-cooling of cylinder barrels on Ranger "in-line" aircraft engines during World War II, the Fairchild Engine and Airplane Corporation developed the "Al-Fin" process for molecularly bonding a finned aluminum muff to the thin-walled steel cylinder liner. Such bi-metallic cylinder barrels combine the high heat conductivity and light weight of aluminum with the strength and resistance to abrasive wear of an alloy steel.

Pure aluminum or any of its alloys can be integrally joined to ferrous metals in this way. The patented process has been made available to industry under a licensing arrangement, and is being applied for a variety of uses. A group of typical parts that have been produced by this process may be seen in Fig. 1.

Fig. 1. A variety of bi-metallic parts produced by the "Al-Fin" process in which pure aluminum and its alloys are integrally joined to iron or steel inserts or liners

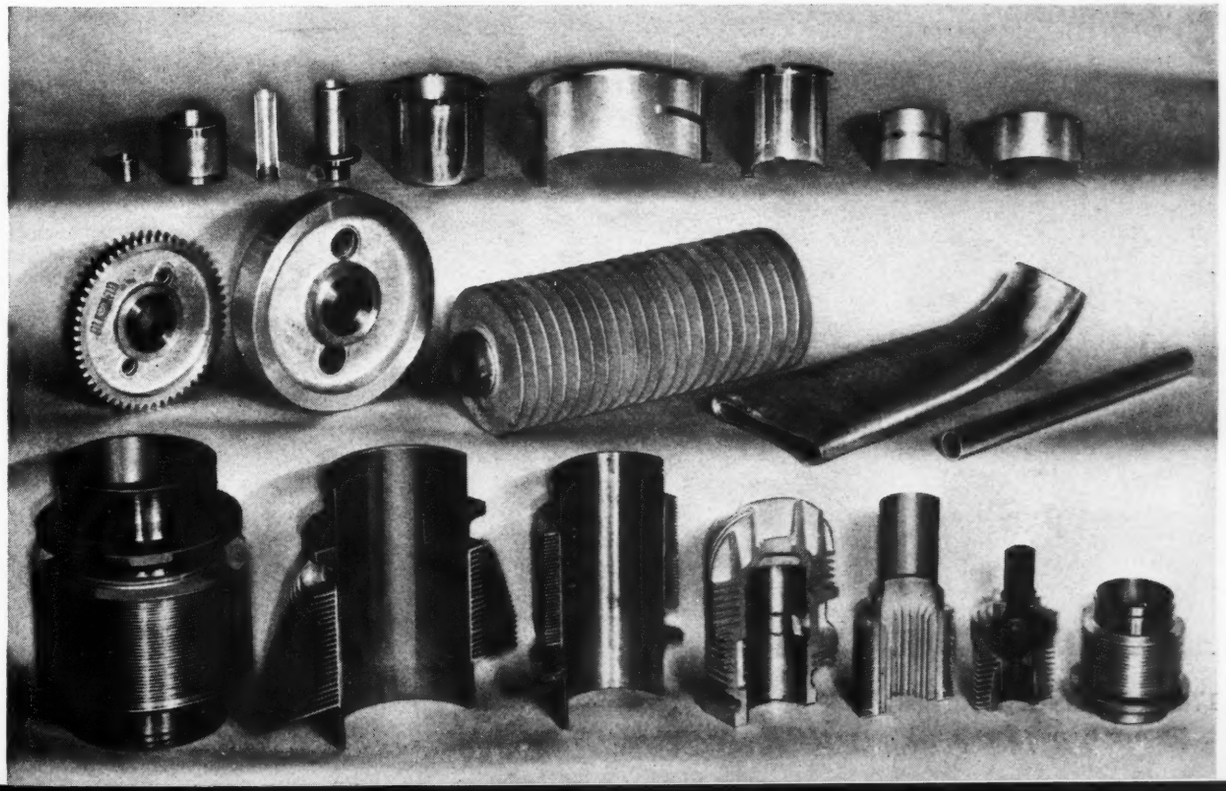


Fig. 2. View of the small foundry employed at the Al-Fin Division for research and development work in the casting of bi-metallic products

The "Al-Fin" process consists essentially of casting molten aluminum alloy around a specially prepared surface of the ferrous liner or insert. Oxide and foreign matter are ordinarily removed by sand-blasting from the surfaces of the iron or steel part to be bonded.

Suitably cleaned ferrous components are then immersed in a bath of molten aluminum. A battery of Hevi-Duty electrically heated furnaces, Fig. 2, is employed for melting the aluminum. A small foundry is maintained at the Farmingdale plant for research and development work, the production of specific bi-metallic products being carried on in the foundries of licensees.

The temperature of the furnaces is maintained at from 1200 to 1450 degrees F., depending upon the melting point of the aluminum alloy being used. Automatic recording and controlling potentiometers are used to keep the aluminum alloys at the predetermined temperatures for bonding and casting. Close control of the bonding as well as of the casting temperature is necessary.

Fig. 3. Suitably cleaned ferrous parts of the bi-metallic components are immersed in a bath of molten aluminum until they reach the temperature of the bath

When the ferrous part reaches the temperature of the bath, the iron reacts with the molten aluminum to form an aluminum-iron alloy on the cleaned surfaces of the part. Several minutes are generally required to bring the part to the desired temperature, the exact time of immersion depending upon the volume of metal being heated. Further heating or holding at the bonding temperature tends to increase the thickness of the bond. In bonding aluminum to steel, a maximum bond thickness of 0.001 inch is usually maintained.

The ferrous part is then removed from the bath, as shown in Fig. 3, and placed in the sand, semi-permanent, or permanent mold. Molten aluminum casting alloy is poured into the mold, as seen in the heading illustration, and fuses with the still molten coating on the hot ferrous piece.

Conventional casting practice is followed in the "Al-Fin" process. Care must be exercised in dipping and pouring the molten aluminum to minimize the formation of oxides in the casting. Between castings, the permanent mold is sprayed with a wash to prevent the molten metal from freezing to the mold and to help control the rate of solidification.

The bond formed between the ferrous member and the aluminum structure is basically an intermetallic compound of iron and aluminum, varying in iron or aluminum richness in proportion to its relative proximity to the ferrous or aluminum components. Photomicrographs of the intermetallic bond formed between various types of ferrous metals and aluminum, at a magnification of about 250, are shown in Fig. 4. Conductivity tests have shown that a bond thickness of 0.001 inch or less does not measurably impair the heat transfer between the ferrous part and the aluminum. In fact, one of the latest successful applications of the new process is the bonding of 1/8-inch thick aluminum to the bottom of stainless-steel cooking utensils to provide better heat conductivity and to eliminate hot spots, scorching, burning, and discoloration of the stainless steel.

A high degree of hardness (about 875 Vickers), with correspondingly low ductility, is obtained in the bond. In tests conducted on aluminum-steel bi-metallic samples, the tensile strength of the bond in tension ranged from 11,000 to 17,500 pounds per square inch. The shear value of the bond is approximately 7000 pounds per square inch.

Since the coefficient of expansion of most aluminum casting alloys is about twice that of the majority of ferrous alloys, this fact must be taken into account in designing for a bi-metallic

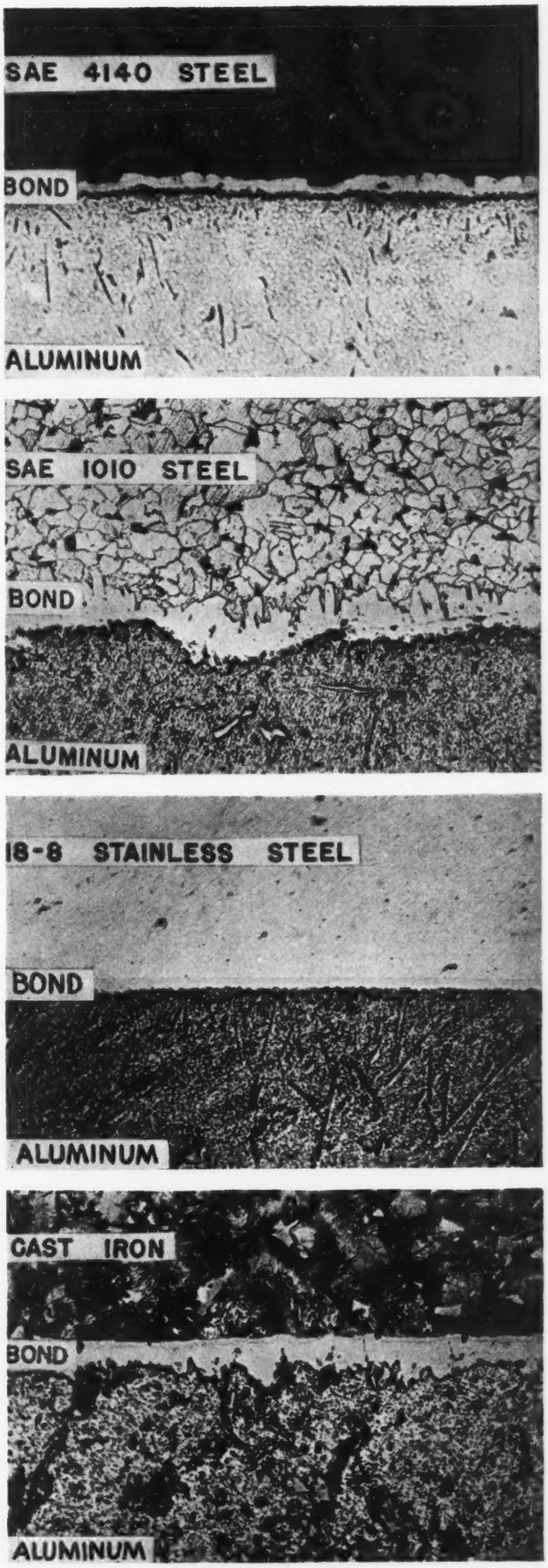


Fig. 4. Photomicrographs, magnified approximately 250 times, showing the molecular bond that is formed between various types of ferrous metals and aluminum

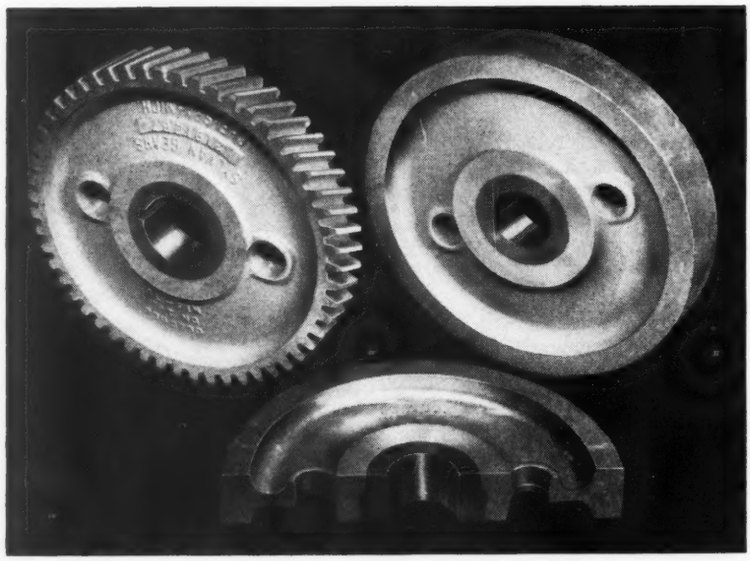


Fig. 5. Aluminum-alloy timing gear with bonded steel hub. A cast gear blank is seen at the right, with a section of the casting below

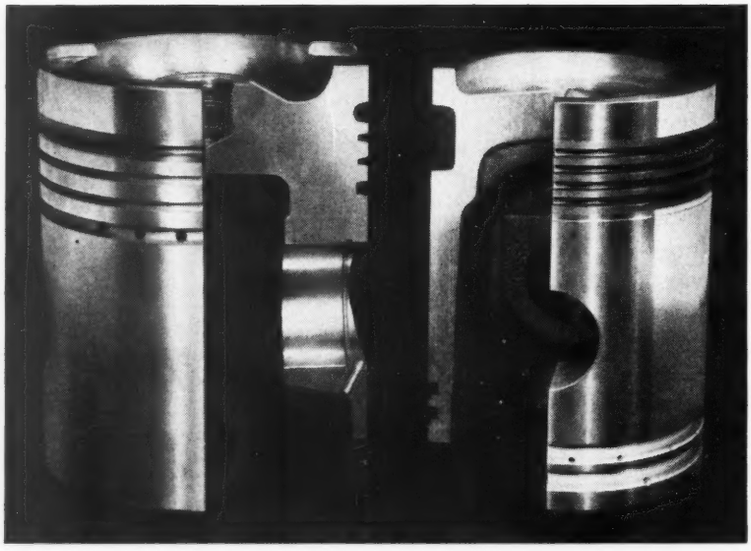


Fig. 6. Cast-iron ring carriers, bonded to aluminum-alloy pistons by the "Al-Fin" process, serve as wear-resistant seats for piston-rings

Fig. 7. A large bi-metallic transmission cover housing weighing 56½ pounds. The steel insert bonded to the aluminum casting weighs only 8 pounds

application. The temperatures at which the bi-metallic unit is to operate must be considered in order to limit the stresses caused by the differences in thermal expansion. Careful attention should be paid to the thickness of the aluminum alloy relative to the ferrous component, and sound design must be used to prevent failure at the bond line when the assembly is subjected to high operating temperatures.

One successful application of the "Al-Fin" process in the automotive industry is in the production of aluminum-alloy timing gears with bonded-in steel hub. The new gears, one type of which is seen in Fig. 5, are stronger and have a much longer life than the molded resin and fiber gears used in automobile and truck engines. The operating noise level of a carefully machined and shaved aluminum gear is comparable to that of ordinary molded resin gears.

Another important automotive application is in the manufacture of bi-metallic pistons, Fig. 6. Aluminum-alloy pistons are provided with a bonded cast-iron ring carrier, which serves as a wear-resistant seat for the upper compression piston-ring only, as seen at the left, or for all of the rings, as shown at the right. Piston life is lengthened considerably by reducing ring land wear to a minimum. The grooved ring inserts are generally made from an austenitic cast iron, "Ni-Resist," containing a high percentage of nickel, although gray iron of low modulus is also used.

A relatively new application in the automotive industry, but one that has considerable possibilities, is a bi-metallic brake drum, composed of aluminum cooling fins integrally bonded to cast-iron liners. Heat generated by braking action in the bi-metallic drum is more rapidly dissipated than in the standard cast-iron drum because of the higher thermal conductivity of aluminum and the increased effectiveness of fins as a heat exchanger.

The bi-metallic drum also offers a marked reduction in brake "fading" because of lower operating temperatures. Other advantages include longer drum and lining life with no cracking, reduced heat checking, and less frequent lining adjustments and replacement. Weight reduction, compared with drums made entirely of cast-iron, ranges from 30 to 50 per cent.

Excellent results have been obtained in the application of bi-metallic brake drums to midget racing cars, where the drums are directly exposed to high-velocity air streams. Consistent braking effect, with no "fading," is obtained, the brake linings have a much longer life, and the total weight of the car is reduced.

A substantial weight reduction has been effected by the use of bi-metallic housings in place of cast-iron housings. The large aluminum transmission cover housing with steel insert seen in Fig. 7 is a typical example. This assembly weighs 56 1/2 pounds. The insert, made from S A E 1020 steel, weighs only 8 pounds. The bonded-in insert is vibration-proof and leak-proof, even to hot oil and gases. Other aluminum housings are made with bonded-in steel bearing cages and shaft-hole reinforcements.

Considerable testing and development are being carried on with steel-backed, bonded aluminum bearings and bushings, such as those seen in the top row of Fig. 1. By bonding a thickness of only 0.010 to 0.015 inch of aluminum to a steel shell, the excellent bearing qualities, including low coefficient of friction and high coefficient of heat transfer of the aluminum, are coupled with the load-carrying capacity and fatigue resistance of the steel. Pure aluminum with 6 per cent tin added is generally used for lining the bearings.

Proposed Tri-Nation Unification of Nuts and Bolts

Proposals have been made to unify nut and bolt practice in the United States, Great Britain, and Canada so as to facilitate interchangeability of industrial and military equipment of these countries. This is a logical step following the tri-nation unification of screw thread systems, which was agreed upon in November, 1948.

A British-Canadian-American Conference on bolts, screws, and nuts was held on June 1 and 2 at the Hotel Statler in New York under the sponsorship of the American Standards Association and the American Society of Mechanical Engineers, with H. W. Robb, of the General Electric Co., as chairman. Sir Anthony Bowlby, leader of the British delegation, stated that Great Britain had decided to propose unification in so far as possible on the basis of present American standards.

The recommendations must be approved by technical associations corresponding to the American Standards Association, the American Society of Mechanical Engineers, and the Society of Automotive Engineers in this country to become effective in the cooperating countries.

Some Points to Consider in Designing Dies

By FEDERICO STRASSER

DIE design and construction often require the solution of problems in machining, heat-treating, maintenance, and other matters that tax the ingenuity of the designer and toolmaker. Some points on die design based on experience are given in the following.

Die Clearance—The straight clearance hole under the blanking or punching opening shown at *A* in Fig. 1 can be made quickly by drilling or boring. The sides of this hole, however, present an unrelieved surface where slugs may jam and pile up, as shown at *B*. In order to prevent this condition, the clearance hole under a straight land is often taper-reamed to provide a 1/2 to 1 degree angle on each side, as indicated at *C*. In many cases, a punching die is designed with no straight land, as seen at *D*, to gain longer cutting edge life. Inasmuch as the diameter of the punched hole in the work is determined by the punch diameter rather than the die opening, the accuracy of the work is unaffected by enlarging the die opening when regrinding becomes necessary for sharpening purposes.

Die Fastenings—After stock cutting pressures have been accounted for, other factors to be considered in determining the height of the die-block are considered. Among these are the strength requirements of fastening screws. The length of tapped holes for these screws must be such as to provide sufficient strength for resisting the stresses produced by stripping action. This amounts to approximately 10 or 15 per cent of the cutting pressure.

In cases where die-holders are not used, tapped holes need not be run all the way through the die-block, but may be relieved, as shown at *A* in Fig. 2, by a drilled hole. When the die-block is to be fastened to a holder, a through tapped hole can be utilized for both the stripper and die assembly screws, as seen at *B*.

Sectional Dies—Ordinarily, dies of various types are made of solid pieces of steel. Occasion-

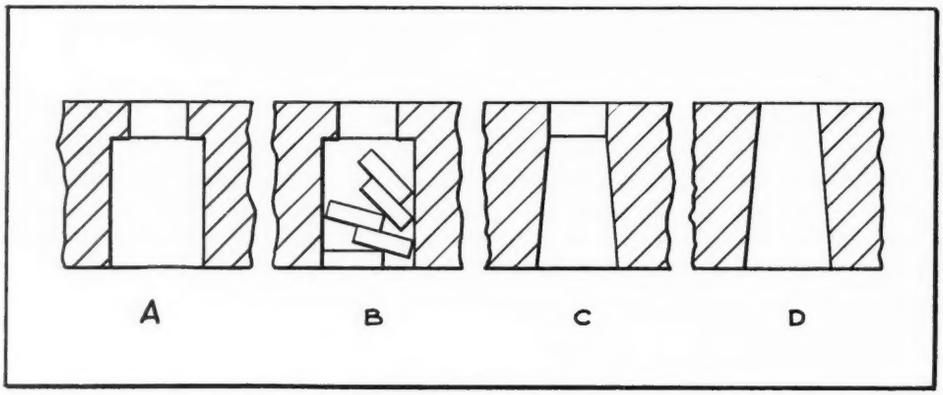


Fig. 1. One of the disadvantages of a straight clearance hole under a die, as indicated at (A), is illustrated at (B), which shows how jammed slugs pile up. Clearance holes with tapered sides are shown at (C) and (D)

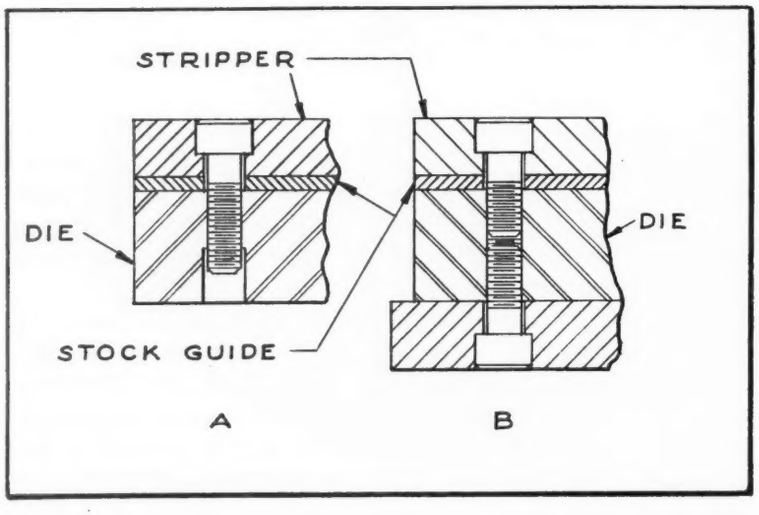


Fig. 2. Tapped holes in die-blocks are often relieved, as shown at (A). When die-holders are used, one tapped hole can be employed for both the stripper and the die assembly screws, as indicated at (B)

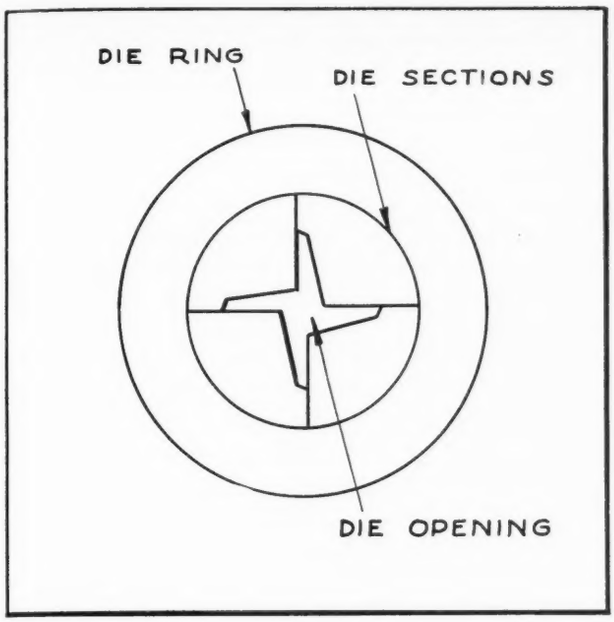


Fig. 3. Many advantages are gained by the use of die sections to form work with complex contours

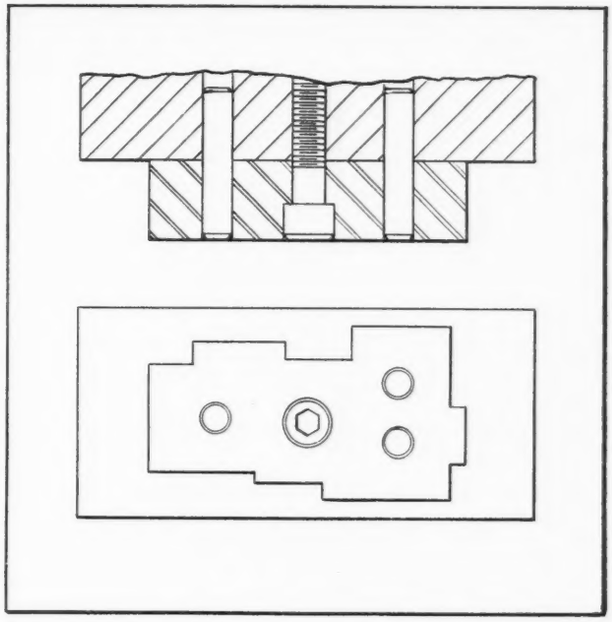


Fig. 4. Punches requiring irregular contours are usually made in two parts instead of one

ally, however, advantages are gained by employing the sectional construction shown in Fig. 3. Among the advantages may be mentioned the following:

1. Economical construction of dies having complicated contours, including sharp corners, projections, etc. Sectional dies simplify machining problems and reduce heat-treating hazards. Moreover, they minimize the use of high-grade tool steels, since these materials are used only in the actual working parts, the die rings and holders being made of machine steel.

2. Interchangeability of dies in standard holders, permitting different contours to be produced by the use of a single holder.

3. Simplified repair or replacement of worn or damaged dies.

Various means are employed for holding the die sections in the rings, including shrink fits, clamping screws, etc.

Trimming in Follow-Dies—Considerable expense can be saved in die construction and maintenance by the use of trimming stations in follow-dies. For example, instead of producing a part

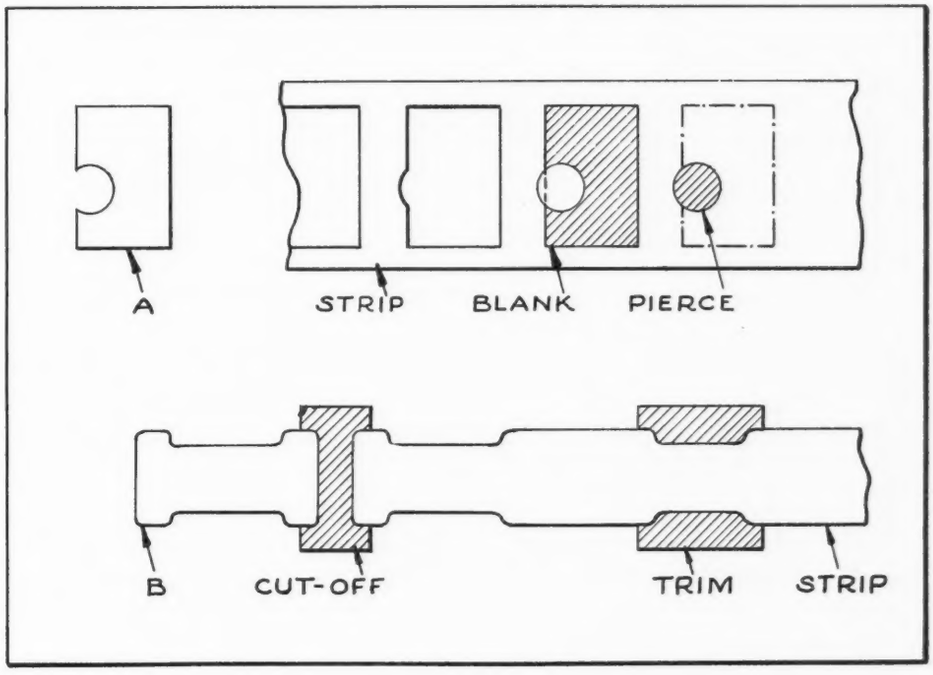
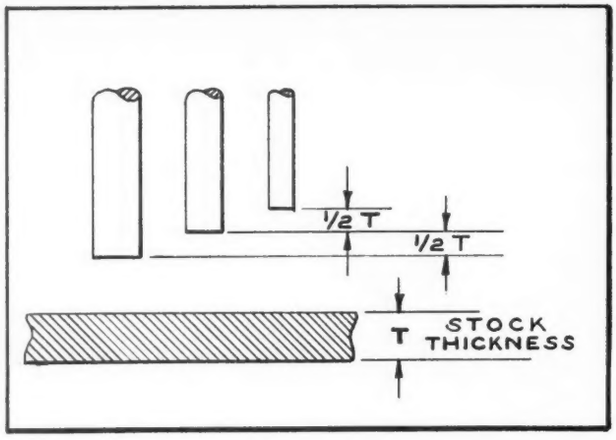
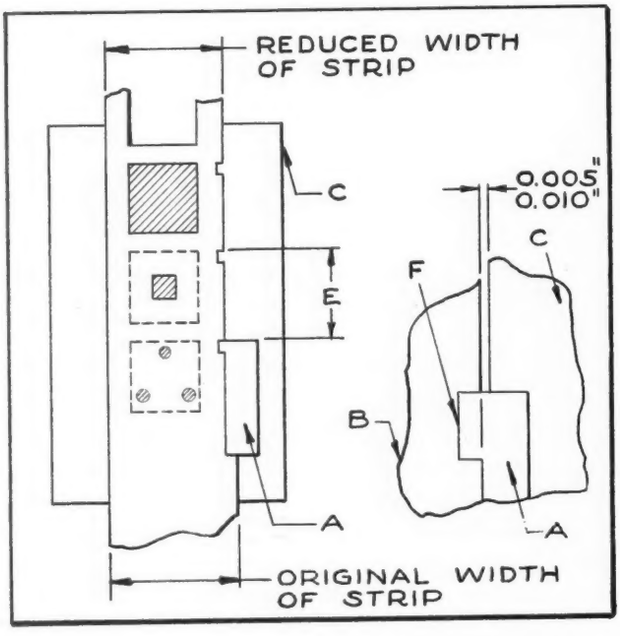


Fig. 5. Trimming stations in follow-dies are widely used to eliminate weak punch and die sections





such as that shown at *A* in Fig. 5 by means of a single-station blanking die, which would require a weak section and a complicated punch to form the part, a follow-die having two stations can be employed, as indicated by the strip at the right. A round piercing punch, positioned to extend slightly beyond the edge of the blank, is used at the first station. The blanking station, following the piercing operation, removes from the strip a trimmed rectangular part with a circular section cut out of it.

Another follow-die used for trimming may be seen at *B*. Here each side of the strip is notched or trimmed at the first station, and at the second station a cut-off die separates the work from the strip after forming the back end of one part and the front end of the succeeding part.

Punch Construction—Punches can be made in two pieces, consisting of a hardened tool-steel cutter and a machine-steel holder. Since it is important that good alignment be maintained between these members, dowel-pins are used with the fastening screws. It is unnecessary for a holder to have the irregular contour of the punch, as seen in Fig. 4.

Sometimes it is possible to use an accurate, self-aligning drill chuck for holding small, round punches employed in short-run production. When the stock thickness is comparatively large and numerous small punches are positioned close together, punch lengths should be varied. As illustrated in Fig. 6, the larger punches are made longer than those of smaller cross-sectional area. This eliminates side strains on the smaller punches and reduces the pressure to that needed

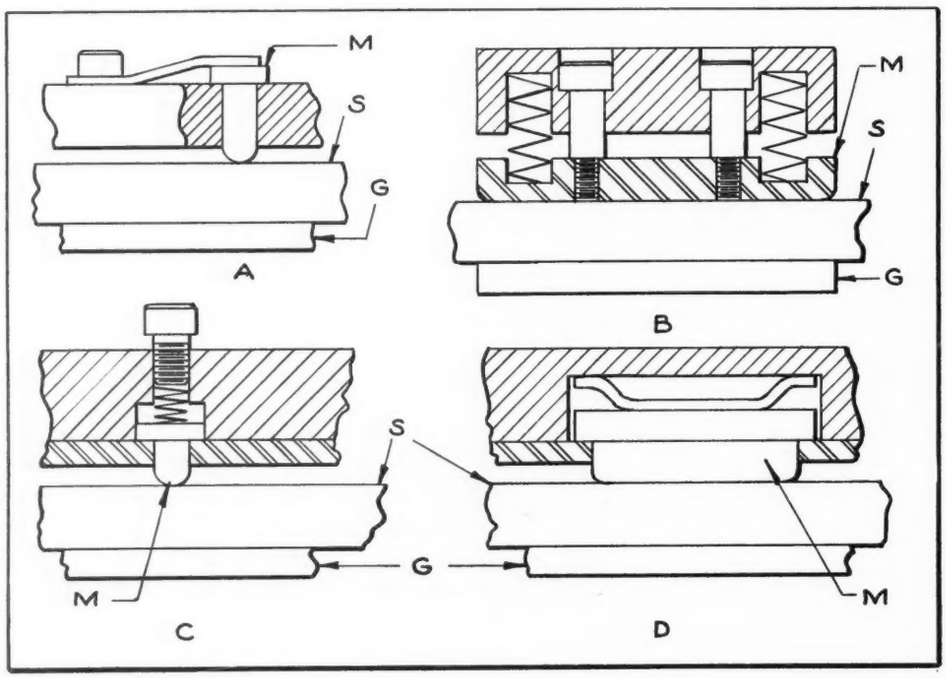


Fig. 6. (Top Right) Where it is necessary to use several punches in a die assembly, the larger ones are made longer than those of smaller cross-sectional area

Fig. 7. (Center) Automatic stops such as here illustrated increase the production rates of progressive dies

Fig. 8. (Bottom) Various designs of movable stock guides (M). The stock is indicated by the letter (S) and the stationary guide by (G)

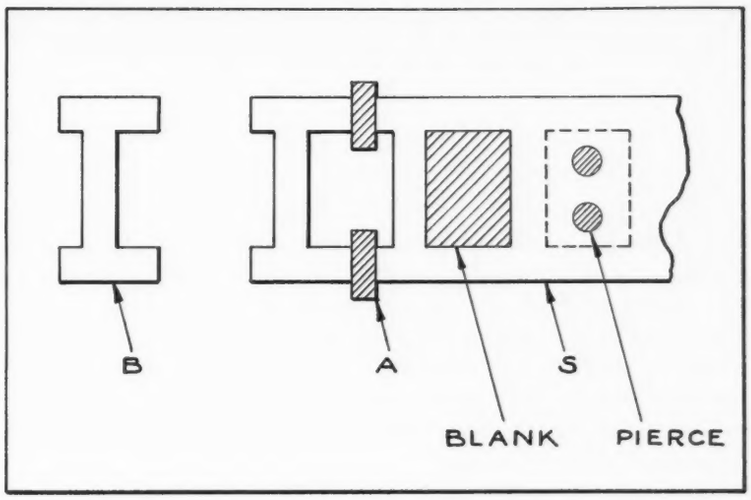


Fig. 9. To facilitate the handling of long strips (S) from which pieces have been blanked, scrap-cutters (A) are utilized in dies to produce small pieces of scrap (B)

for piercing the larger holes only. The larger punches are generally made longer by an amount equal to one-half to three-quarters of the stock thickness.

Automatic Stops—Production rates can be increased considerably by the use of automatic stops. Of the many types used, the stop illustrated in Fig. 7 is particularly efficient. A supplementary member of the die assembly *A*, known as a "pitch punch," shears the edge of an over-size strip *B*, entering an opening in a hardened stock guide *C* to do so. The stock guide is stepped, so that the over-size strip is guided back of the "pitch punch" and also in front of it after the stock is reduced to the required width.

It can be seen that each advance of the strip through distance *E* brings the end of the over-size section against a positive stop provided by the projecting section of the stock guide. Approximately 0.005 to 0.010 inch clearance between the reduced strip and the stock guide is provided, as shown in the enlarged view. The small notch made in the stock by the projection *F* on the "pitch punch" eliminates burrs, which would hinder the advance of the strip. One of the advantages of this type of stop is that it does not require the attention of an operator.

Stock Guides—Movable stock guides are useful in progressive dies where strip widths are not always uniform or where the processing of the strip through the die causes variations in the width. One stationary guide is generally used with a movable guide to insure the positioning of the strip against a definite surface.

Some examples of movable stock guides are shown in Fig. 8 at *A*, *B*, *C*, and *D*. In each case, the letter *M* indicates the movable guide, *S* the strip, and *G* the stationary guide. Spring pressure is utilized in all these designs to permit movement of the guide *M* when variations in stock width occur and to maintain a pressure on the strip to keep it against the stationary guide *G*.

Scrap Cutters—In order to facilitate the handling of scrap, long strips from which pieces

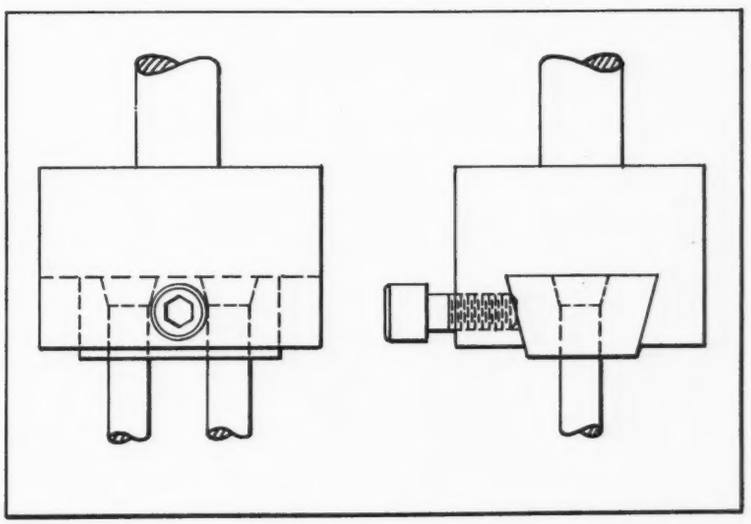


Fig. 10. Example of a standard design of dovetail punch-holder. Such standardized construction methods reduce set-up time considerably

have been blanked are often cut up by means of scrap cutters. A typical arrangement for this purpose is shown in Fig. 9. The cutters are indicated at *A*, the strip at *S*, and the scrap at *B*.

Standardization—Tool designers should consider the availability of standard parts for use in die construction in order to eliminate unnecessary tool-room work. These include dowel-pins, die springs, die sets, stops, bushings, and numerous other items. When dies are made reasonably often, standard parts of this type should be stocked, ready for use when needed. By employing standard drill rod for small, round punches, considerable time will be saved when replacements are required.

Whenever possible, dies should be designed for maximum interchangeability. Adapters to suit various press rams, punch- and die-holders, and other devices can be designed so that dies can be set up on one press or another without delay or changes in construction. An example of a design that can be made standard for holding punches is illustrated in Fig. 10, where a dovetail punch-holder is shown assembled with a punch plate having mating dovetail sides. Similar arrangements can be made for holding dies in presses. Such standardized construction methods reduce set-up time considerably.

By maintaining a file of existing dies and other press equipment, a tool designer can often utilize tools for more than one job.

* * *

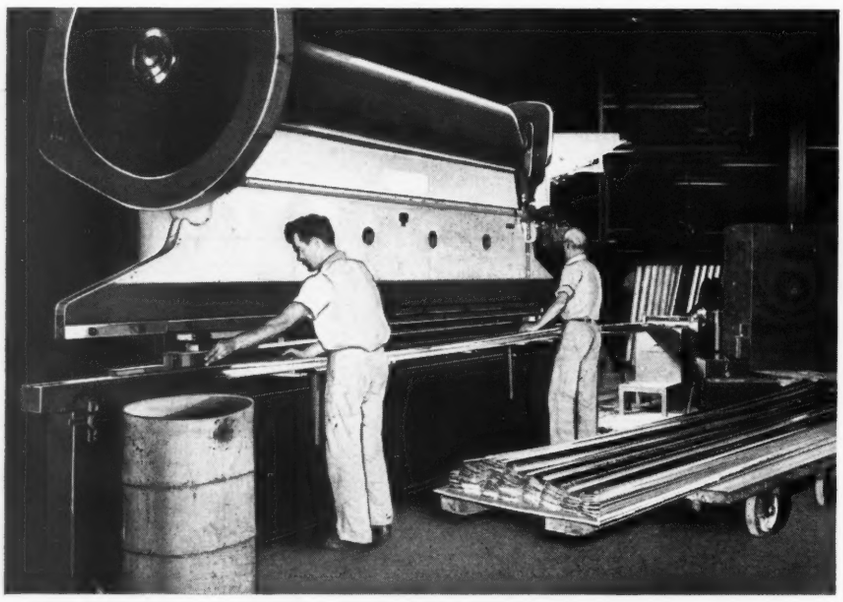
Chromium-plated cylinder liners and silver-, lead-, and indium-plated bearings of present-day aviation motors outwear unplated liners and bearings by ten to one, according to the American Electroplaters' Society.

Die that Eliminates Ten Operations

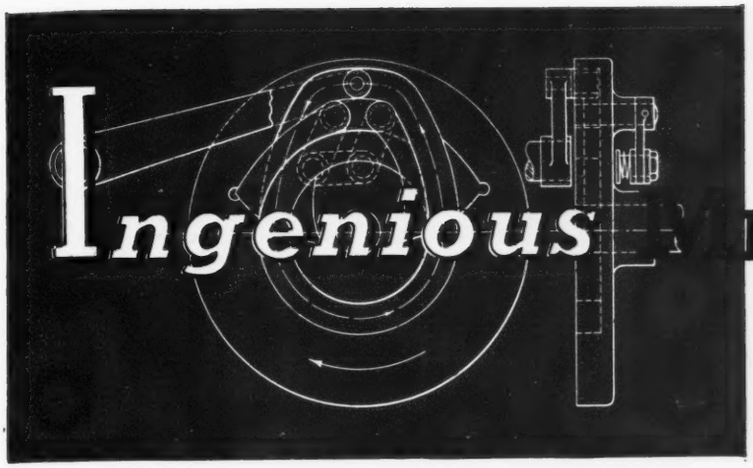
A combination blanking and forming die developed by the Texas Engineering & Mfg. Co., Inc., Dallas, Tex., for use on the 16-foot Cincinnati press brake seen in the accompanying illustration has enabled the time required for forming aluminum spray rails for boats to be reduced by more than 80 per cent. The new die permits the entire rail to be formed in one operation, as compared with the eleven operations previously required. Also, because of its sectionalized construction, the same die can be used to form parts of eleven different lengths ranging from 84 to 195 inches.

The spray rails are formed from 24S-O aluminum-alloy coil stock, 4 inches wide by 0.040 inch thick. By the method previously employed, the stock was first cut roughly to length, after which a stiffening bead was formed in three separate brake operations. The pieces were then trimmed to exact length, following which two separate operations were performed on a punch press to flatten the ends of the rails. Finally, the corner radii were cut with snips, which required four additional operations.

With the new die, the coil stock is fed directly to the press brake with power rollers controlled by foot operation. A single stroke of the press brake forms the rail, flattens the ends, cuts the part to exact length, and rounds the corners. This method enables one operator and a helper to produce 900 parts in an eight-hour day. The two end sections of the die include the blanking dies, and are set up to suit the length of rail. Straight forming dies of different lengths are then filled in between the end sections.



Time required to produce aluminum spray rails for boats has been reduced by more than 80 per cent by equipping this press brake with a combination blanking and forming die



Ingenious MECHANISMS

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and other Devices

Ejecting Mechanism for Die-Casting Die

By CLIFF BOSSMANN

In designing dies for die-casting, it is sometimes necessary to provide a short ejection stroke for use with a long press stroke. This can be accomplished with the design illustrated in Fig. 1. Here the die-casting die is shown in the closed position. The ejector-plate assembly *A*, carrying the ejector-pins *B*, is moved only a fraction of the total press stroke, as indicated in Fig. 2.

A rack *C*, Fig. 1, attached to the ejector-plate assembly, is moved a distance that varies with the arc through which the driving pinion *D* rotates. The pinion is keyed to an arm *E* which is linked to a crank *F*. Rotation of the pinion occurs, therefore, only when arm *E* is turned by the crank.

A roller *G* on crank *F* is moved along the circular surface of a guide block *H* by the connecting-rod *J*. Since the surface on which the roller travels is an arc having a center *P* that is also the pivot point for crank *F* and arm *E*, the arm will not turn until the crank is moved a distance greater than the radius of the arc. This occurs when the roller reaches the end of the circular surface and moves outward along the angular surface *Y* on the guide block.

The connecting-rod *J* is attached at the end opposite roller *G* to the movable die section *K*, which is connected directly to the press ram. This end of the connecting-rod moves in a straight path for a distance equal to the full press stroke. In doing so, it pulls the roller along the circular surface of the guide block, rotating crank *J* through an arc having a constant radius. No rotary force is transmitted to arm *E*, however, until the roller reaches surface *Y* on the guide block, as mentioned, when the crank movement becomes radial rather than rotary.

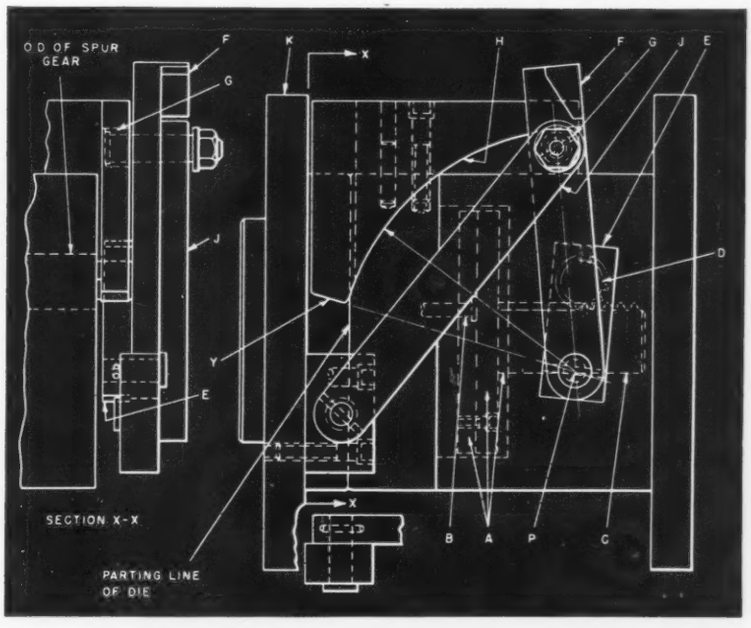


Fig. 1. Ejecting mechanism for a die-casting die that provides a short ejection stroke for use with a long press stroke. Length of arc through which roller (G) travels equals the difference between press stroke and ejection stroke

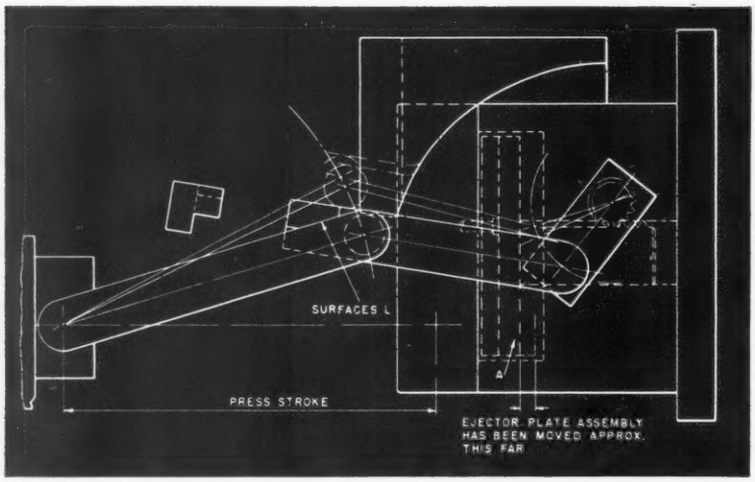
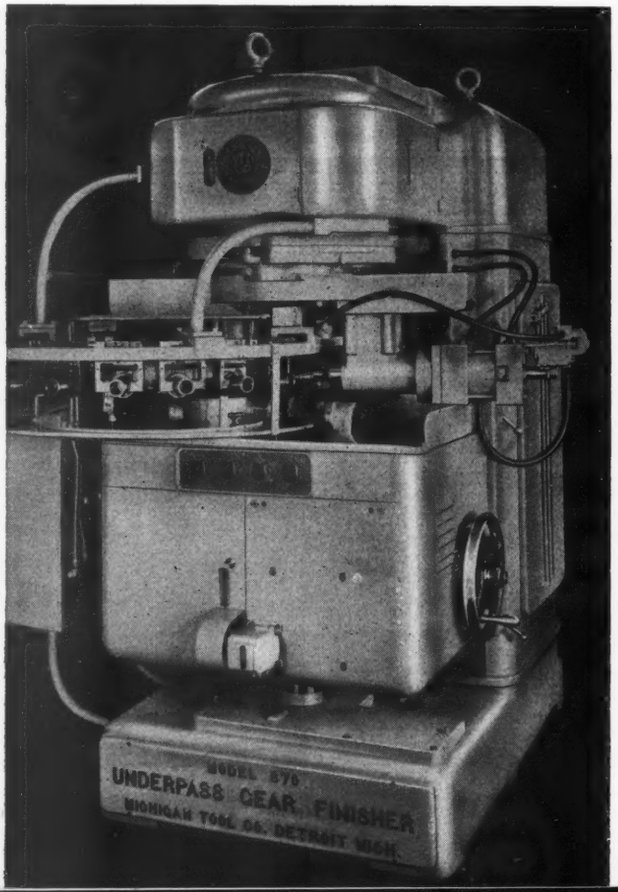


Fig. 2. Comparison between length of press stroke and ejection stroke obtained with mechanism illustrated in Fig. 1. Dot-and-dash lines indicate different arc lengths used to provide various lengths of ejection stroke

This movement is made positive by contact between the two mating surfaces *L*, Fig. 2, which lock the connecting-rod and crank when this point in the cycle is reached. Continued movement of crank *J*, Fig. 1, along surface *Y* swings arm *E* in an arc, rotating pinion *D* and actuating rack *C* to produce the ejection stroke, which, in this case, amounts to approximately 5 per cent of the total press stroke.

Any other length of ejection stroke may be produced by changing the length of arc or circular distance of the guide block *H*, as indicated by dot-and-dash lines in Fig. 2. Also, by changing the crank and arm lengths, gear tooth ratios, etc., to suit different sets of tools or press conditions, various results can be obtained where similar problems exist.



Rotary gear-finishing machine designed to carry cluster gears automatically through a series of operations

Finishing Gears without Removal from Conveyor

The ability to finish gears automatically without removing them from a conveyor is one of the latest developments in automation. Through an arrangement developed by the Michigan Tool Co., Detroit, Mich., an operator merely places gears on a conveyor as they come from the previous operation. The conveyor carries the gears through the finishing operation, which can be performed on individual or multiple rotary gear-finishing machines. The gears return to the operator for removal from the conveyor. A typical set-up is here illustrated.

This ingenious arrangement was made possible by providing an aperture in the machine column to permit exit of the conveyor. Cluster gears can be passed through a battery of rotary machines, each machine in turn finishing a specific gear of the cluster and the conveyor providing the automatic transfer from one machine to the next.

As a gear is carried into position above the finishing cutter of the machine, air-operated centers engage the gear. Then a mechanical finger comes down on top of spring-loaded jaws that hold the gears on the conveyor to separate the jaws and leave the gear free to move at a crossed axis to the cutter. After the machine goes through its cutting cycle, the mechanical finger is automatically released to permit re-engagement of the gear by the jaws. The centers then retract, the conveyor moves the finished gear out of the cutting position, and the next gear is brought into position. The floor-to-floor time in the operation illustrated is only 20 seconds, the gears being of 14 diametral pitch, 2 5/8 inches in diameter and 7/8 inch in face width.

Tool Engineering Ideas

Tools and Fixtures of Unusual Design, and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

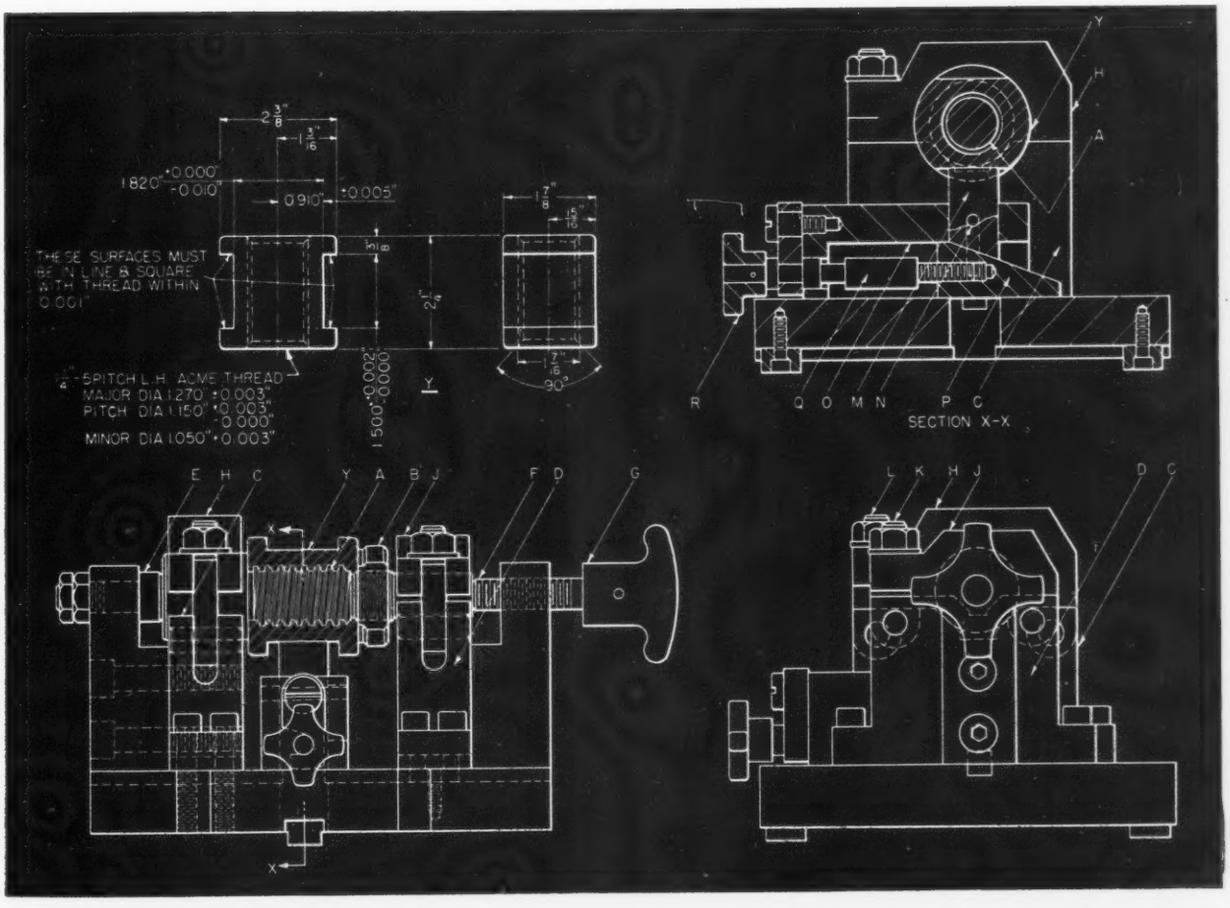
Milling Fixture with Unusual Locating Feature

By ROBERT MAWSON, Providence, R. I.

In producing cast bronze nuts for the column-elevating screws on surface grinding machines, it is necessary to mill a slot on each side of the nut. The sides of one slot must be in line with those of the opposite slot and square with the thread in the bore of the nut within 0.001 inch. The milling fixture designed for locating the work-piece accurately and holding it securely during machining, so that the milled surfaces comply with the requirements for this important machine tool detail, is shown in the accompanying illustration. The bronze nut is seen at *Y*.

The nut to be machined is screwed on arbor *A*. The thread on this tool-steel arbor is ground to a good sliding fit on the thread in the nut. Lock-nut *B* is then applied to the arbor to hold the work-piece against a locating shoulder on the arbor. The loaded arbor is placed in the 90-degree vees ground in support blocks *C* and *D*, which are keyed and bolted to the base.

The arbor is moved to the left, against stop *E*, by rotating screw *F* with hand-knob *G*. Latches *H* and *J*, which pivot on pins passing through the latches and support blocks, hold the arbor in the vees of the support blocks. The latches are held in contact with the arbor by tightening



Special fixture for accurately locating and securely holding cast bronze nuts used on the column-elevating screws of surface grinding machines while milling slots on each side of nut

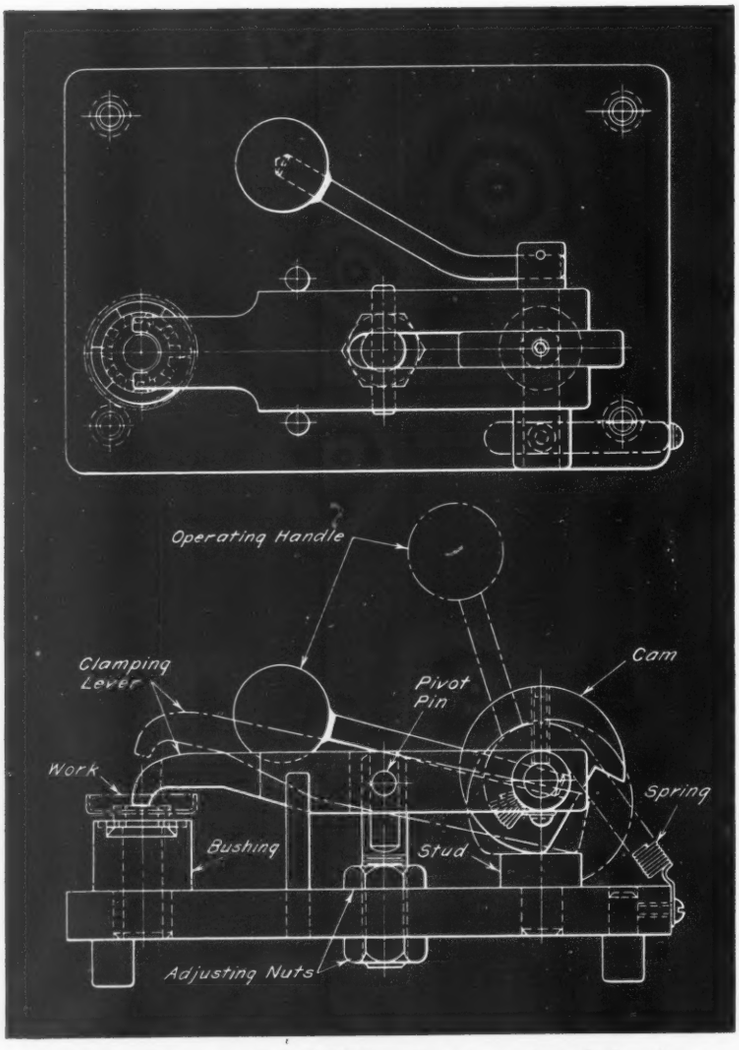
nuts on bolts *K* and *L*, which also pivot about pins passing through the bolts and support blocks.

Post *M*, into which is pressed pin *N* that passes through slots in block *O*, contacts the cast slot on the under side of work-piece *Y*. Block *O* is bolted to the fixture base, and is cut away to accommodate wedge *P* and screw *Q*, which engages a threaded hole in the wedge. With latches *H* and *J* loose, screw *Q* is rotated by means of hand-knob *R*, thus moving the wedge and raising or lowering the post, depending upon the direction in which the screw is rotated.

The lower end of post *M* is forked and beveled to straddle and slide on the tapered surface of the wedge. As the post is raised, the work-piece is rotated until the flat surface at the bottom of the cast slot is horizontal. The latches are then tightened by screwing down the nuts, and screw *F* is given a final twist to insure contact of the arbor with stop *E*.

The milling machine table, with the loaded fixture properly located and secured, is then fed under a rotating side milling cutter, 4 inches in diameter by 1 1/2 inches wide, which is held on an arbor mounted in the spindle of the machine. After machining one slot to the desired width and depth, the machine table is retracted, the latch bolts are loosened, and the latches are swung back from the work-holding arbor. Screw *F* is then loosened and the wedge is drawn forward by rotating screw *Q*.

This movement of the wedge removes the pressure on post *M*, permitting it to drop out of contact with the work-piece. The arbor is then rotated through an angle of 180 degrees in the vees of the support blocks, and the latches are swung back into place. The wedge is now advanced to raise the post into contact with the previously milled slot. When the bottom surface of this slot is horizontal, screw *F* is rotated to bring the arbor into contact with stop *E*, and the latches are secured. The work-piece is now located and held for the second milling operation.



In this fixture, work is held down by a cam-pivoted clamping lever. The lever is lowered by depressing the operating handle, and raised by the action of a spring

Quick-Acting Work-Holding Fixture for Reaming or Burring

By A. C. EAGLE, Dayton, Ohio

A quick-acting fixture for holding parts during reaming or burring operations is shown in the accompanying illustration. Pressure is exerted downward on the work, which is held in a bushing, by a fork-ended, cam-pivoted clamping lever. The work-piece shown in the fixture is a gear assembly, the gear having one full tooth and nine stub teeth. The peripheries of the stub teeth fit into a counterbore in the bushing, while the full tooth enters one of three slots in the rim of the bushing to prevent the work from being rotated during reaming.

The unloading positions of the operating handle, clamping lever, and cam are indicated by broken lines. When the work has been located in the bushing, the operating handle is pushed downward to the position shown. This rotates the cam counter-clockwise, and the action of the cam on the stud causes the clamping lever to pivot about the pin on which it is mounted, so that the opposite end of lever moves

down against the work. The pivot-pin can be raised or lowered by means of adjusting nuts to keep the travel of the handle at a minimum. The operator keeps the handle down during reaming.

At the completion of the operation, the operator throws the handle upward, and it is retained in this position during unloading and reloading by the action of a spring. Clockwise rotation of the cam is limited by a step on the cam coming in contact with the stud.

Straightening Wire in an Electrically Heated Fixture

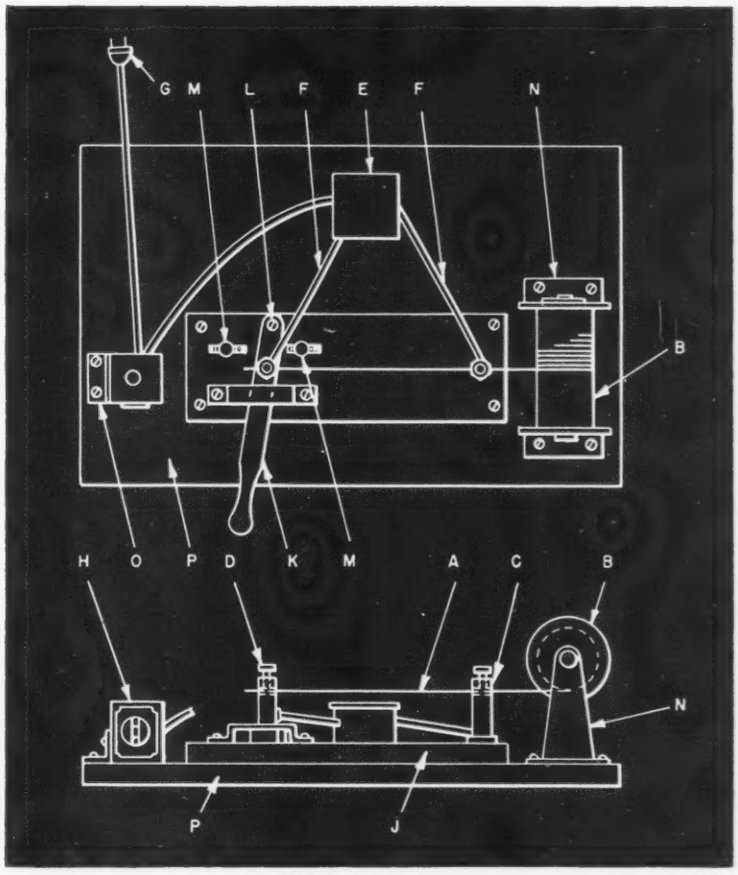
By FRANK J. PERAGINE
South Hempstead, N. Y.

Both time and money can be saved in performing wire straightening operations by the use of the simple fixture illustrated. Straightening is accomplished by applying tension to an electrically heated section of the wire. Bare wire made from steel, brass, copper, phosphor-bronze, German silver, aluminum, or any material that will conduct electricity can be straightened in this manner.

Wire *A* unwound from reel *B*, is fed through the openings in brass posts *C* and secured by means of thumb-screws *D*. The section of wire between the posts is heated by electric current that is delivered to the posts from transformer *E* by lead-wires *F*. The transformer reduces the voltage and increases the amperage of the supply current, which flows from plug *G* through switch *H* to the transformer.

The right-hand post is screwed to a Bakelite contact-board *J*, and the left-hand post to a Bakelite lever *K*. Lever *K* can be pivoted about screw *L*, operating between adjustable stops *M*. When wire *A* becomes heated, the lever is moved to the left to straighten the wire. Brackets *N* that support the wire reel, and bracket *O* on which the switch is mounted, are secured to the wooden base *P* of the fixture.

Wire from 0.005 to 0.032 inch diameter has been straightened on this fixture. Other sizes could be accommodated by providing a variable-output transformer.

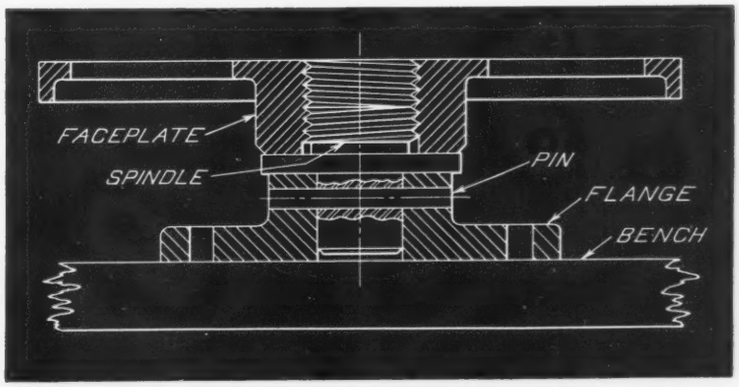


Wire straightening fixture in which tension is applied to the electrically heated wire

Bench-Mounted Adapter Facilitates Setting up Work on Lathe Faceplate

By JOHN HOMEWOOD, Ontario, Calif.

It is often inconvenient or unhandy to set up work on a faceplate when the faceplate is mounted on the spindle of a lathe. The bench-mounted adapter here illustrated will facilitate such set-ups. By removing the faceplate from the lathe and mounting it on the adapter, the



To facilitate setting up work on a lathe faceplate, the faceplate can be removed and transferred to a bench-mounted adapter such as illustrated

work can be easily and accurately set up. The faceplate is then placed back on the lathe.

The adapter consists of a flange which is bolted to the bench top, or secured by C-clamps, and a threaded spindle, provided with a collar that rests on top of the flange. A loose fitting pin is placed through the hub of the flange and the spindle to prevent the spindle from rotating while applying and removing the faceplate. This pin is removed while setting up the work, so that the faceplate can be rotated freely.

Vise with Hydraulic Jaw for Clamping Irregular-Shaped Castings

By EDWIN N. OLSON, Bellflower, Calif.

Multiple clamping of various sizes of irregular-shaped castings can be simplified by means of a vise equipped with a hydraulic jaw, as shown in the illustration. With this arrangement, a uniform pressure is exerted on all of the castings, regardless of variations in dimensions or irregularities in the surface such as are produced by part numbers or names cast on the work. In the set-up shown, six lever castings *A* are clamped simultaneously for machining both sides and the top with the straddle milling cutters *B*.

Hydraulic vise jaw *C* is drilled to provide oil reservoirs *D*, two rows of six pistons *E* fitting into the reservoirs. The oil reservoirs are sealed by means of pipe plugs *F*, and the connecting oil passage *G* is sealed by welding plug *H* to the jaw after drilling. Snug fitting rubber washers *J* are placed in the groove of each piston to prevent the leakage of oil. Plate *K*, which is machined to fit the tapered sides of the castings, is screwed to the stationary vise jaw *L*.

In preparing the hydraulic vise jaw for operation, the reservoirs are filled with oil to within 3/4 inch of the face of the jaw. The pistons are then carefully inserted in the jaw, and the assembly is clamped against some parallel surface to align the tops of all pistons. While clamped, one of the pipe plugs is loosened to permit air and excess oil to "bleed" from the system. This plug is then secured tightly, the assembly is unclamped, and the hydraulic vise jaw is ready for service.

* * *

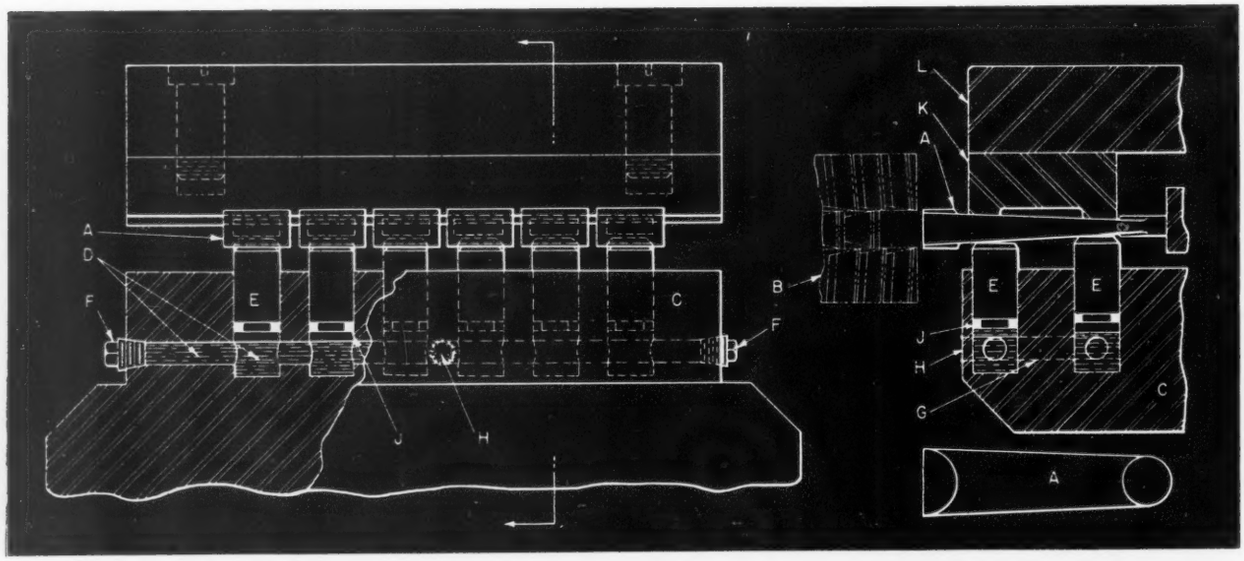
Water-Wheel Generator Still Running after Forty-Four Years' Service

A General Electric water-wheel generator is still being operated twenty-four hours a day at Ephraim City, Utah, after forty-four years of service. For the first five years, the machine was run about sixteen hours a day, but in 1911 it was put into round-the-clock operation, and has been giving almost continuous service ever since.

Driven by a 32-inch diameter impulse wheel, the machine has delivered as high as 200 kilowatts for peaks that lasted about one hour. The original bearings, coils, and other components of the generator have not required replacement.

* * *

Reserves of iron ores in the United States of the kind now in use, plus additional usable ores, are estimated to total over 77 billion gross tons.

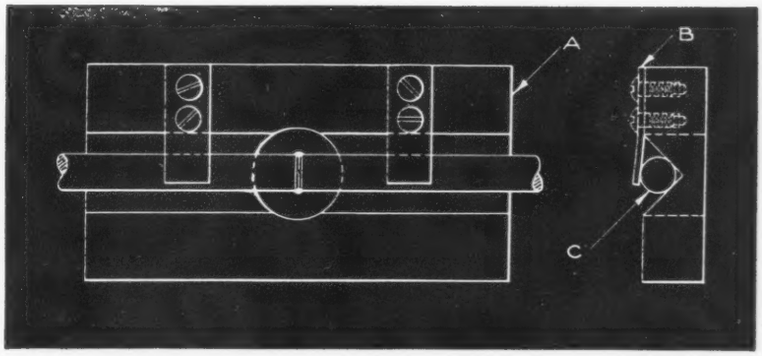


A hydraulic vise-jaw (C) permits uniform pressure to be exerted on all castings (A), regardless of variations in dimensions or irregularities in the surface

Ideas for Shop and Drafting-Room

Simple Jig for Welding Round Work

The accompanying illustration shows a handy jig for butt-welding round objects, such as drills, shafts, tubing, etc. Simple and inexpensive to make, it eliminates the necessity of building a new jig or using cumbersome clamps and vises for each different job.



Simple welding jig that utilizes spring pressure for holding work to prevent warpage and yet permit it to be rotated

The base *A* is made of brass in order to prevent welding spatter from sticking to it. A vee is machined down the middle of the base and a large hole is drilled in the center where the work-pieces are joined. Two pieces of spring steel *B* are screwed to the base to hold the work *C*. The work is placed in the vee under the springs, the pressure keeping the pieces from warping and yet permitting them to turn. R. I.

Easy Method of Removing Slugs from Dies

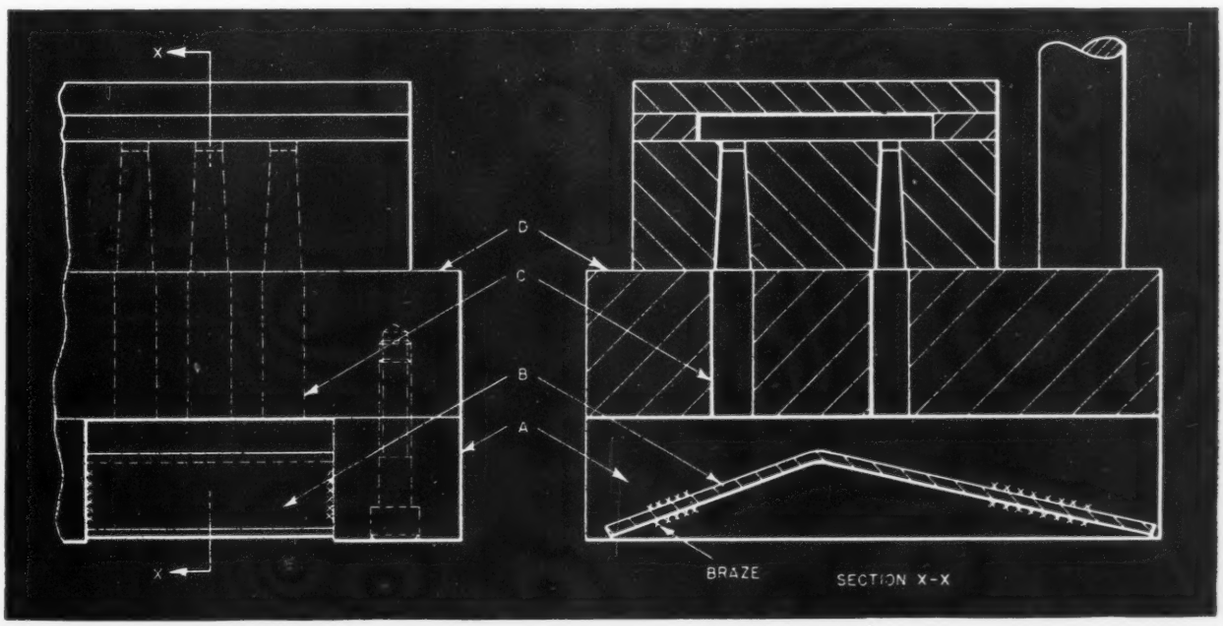
By ROGER ISETTS, Kenosha, Wis.

In piercing large metal sheets where there is no hole in the press bolster plate, the arrangement illustrated in the accompanying illustration will be found a simple and inexpensive method of disposing of the slugs.

A section of cold-rolled steel *B*, approximately 1/8 inch thick and bent as shown, is brazed or welded between riser blocks *A*. Thus, when the slugs pass through holes *C* in die-shoe *D*, they will roll along the bent sheet, either to the front or back of the press. This makes it unnecessary for the operator to be continually pushing the slugs out by hand and also prevents press or die breakage caused by slugs piling up under the die.

* * *

The cost of steel represents less than 10 per cent of the selling price of an automobile.



Steel sheet (B), brazed or welded between riser blocks (A), causes slugs produced by piercing punches to roll to the front or back of the press on which the die is mounted

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
Lester, Hankins & Silver
Sales Management Engineers
New York and Philadelphia

"Back Tracking" May be Expensive

THE only way we get orders for machine shop equipment is by "back tracking"—repeatedly contacting the prospect. But one way we may lose orders is by "back tracking" to get missing information that we should have got before. This kind of "back tracking" is always expensive.

Delving reminiscently into the realm of history, an elderly executive of a leading machine tool builder told me of an incident that happened at the start of this century. A salesman sent in an order specifying that an electric motor must be supplied to power the tool. This startling request was the first one of the kind ever received. Since no further information was furnished, the home office wired the salesman: "Is an alternating- or a direct-current motor needed?" A telegram came back, "Use your own judgment."

This incident shows not only the progress made in our tool developments since then, but also the loss involved in having to "back track."

Even today, many of us lose time and effort simply because we fail to obtain the necessary information when the "getting is good." Not only do we lose time and energy, but we give the prospect unnecessary work. He is probably irritated. His confidence in us and our company as a potential supplier drops down a peg. We are discounted. Beyond this, the men at our own headquarters are put to additional work. They are not mind readers, and can only work upon the information we give them. In short, one small item of missing information can cause inordinate loss through multiplication.

Of course, the up-to-date company supplies its sales engineers with a guide showing the necessary information for preparing the machine equipment estimate or quotation. But even the most complete guide will not include every point necessary in preparing the best possible bid. On the sheet showing required data for bidding, there is usually space left for "remarks." What the salesman puts down under this heading may be vital to a competitive bid.

Many of us have heard an estimator say: "Had I known that condition existed when I made the estimate, I could have knocked off $500 from the price." And the reverse is true when the salesman fails to specify some particular requirement. To satisfy the purchaser, expense modifications may become necessary, resulting in "red ink" rather than "black."

Here are some elementary yet typical examples of loss in selling effort due to missing data:

One salesman in analyzing requirements for a group of tools to operate in sequence forgot to mention a hardening process on the parts that had to take place between machining operations. Another salesman failed to give complete specifications on the materials to be machined. In one case, the lowest price estimate was not supplied because the salesman failed to point out that three additional duplicate machines would probably be needed within a year's time.

Another bid was prepared without emphasizing the uniformity of finish required in a grinding operation, about which the prospect was especially fussy. One salesman failed to specify that the tool should have additional potential capacity due to future probable working conditions. In still another case, the estimators were misled because the salesman stated that his chief competition would be Continental's XY machine, not Continental's new XYZ improved machine. Again, there was an instance of a salesman who spent time and effort on a formerly unknown prospect, simply to find out later that the company was financially shaky.

Accuracy, resourcefulness, imagination, and experience are needed to avoid costly "back tracking" and attain success in selling.

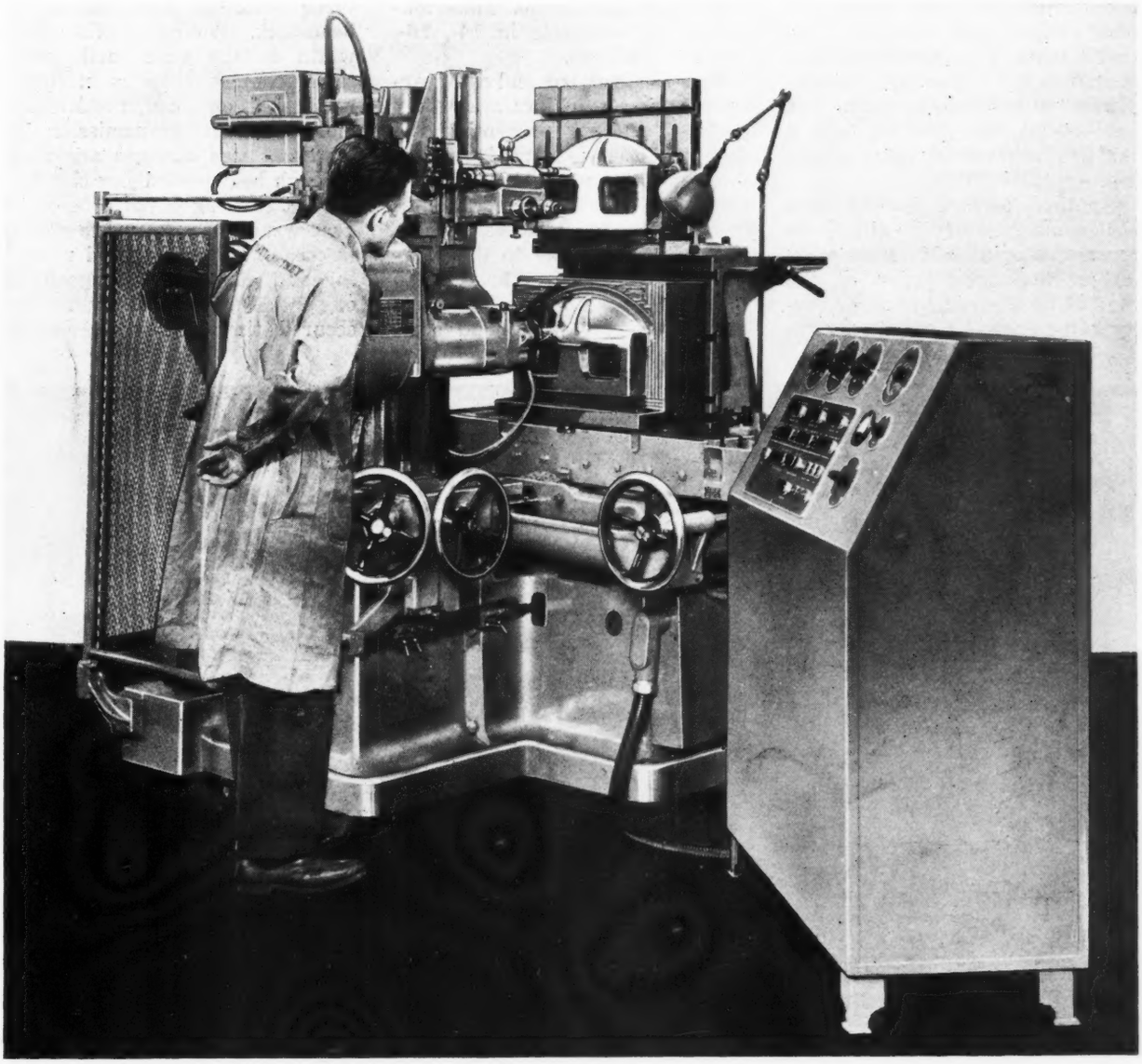
Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Pratt & Whitney-Keller Tracer-Controlled Milling Machine of Improved Design

Many improved features have been incorporated in the Keller BL tracer-controlled milling machine built by Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn., that will substantially reduce the time required to produce dies, molds, experimental parts, and irregular-shaped pieces. A new automatic electric tracer control has been developed that enables the tracer to glide smoothly over any contour two to three times faster than was previously possible on finishing operations. The automatic tracer, operating in conjunction with an automatic variable-speed control, provides continuous variation of the individual machine motions in proportion to the slope being followed.

New drive units for the vertical, horizontal, and transverse



Improved Pratt & Whitney-Keller tracer-controlled milling machine

movements of the machine, with an increased range of travel speeds and step feeds, replace the old style drives with their four gear shifts. The new units have a single shift and magnetic clutches driven by individual variable-speed motors. The magnetic clutches are engaged or disengaged instantaneously either by push-button control or the tracer.

The new travel speeds are infinitely variable from 0.5 inch to 30 inches per minute, and are completely controlled from the operator's position through solenoid shift of the gears and rheostat control of the motors. Step feeds of limited range, previously set at each gear-box, have been replaced by a single unit, mounted in the control cabinet, giving a feed range of 0.010 inch to 4 inches, in steps of 0.010 inch.

To prevent cutter breakage by overloading, there is a power limiting circuit which interrupts the travel when a preset cutter load is approached. Thus the cutter is allowed to take power up to, but not beyond, the greatest load it can handle safely without breaking.

Another feature in the new Keller machine is its ability to reverse automatically either vertical or horizontal travel at the edge of an irregular form or cavity rather than at a fixed length of travel, thus eliminating non-cutting time. This type of reversing can be used at either end or at both ends of the stroke, or it can be combined with a fixed reversing point at the opposite end of the stroke.

The basic structural design of the machine has not been altered. The horizontal spindle construction permits the use of a constant flood of coolant to wash the chips from deep cavities and allow the cutter to operate at maximum efficiency. The large unobstructed work-table permits direct overhead loading, and also makes it possible to accommodate work that extends far beyond the working range of the machine. With the work-piece and model mounted on the same fixture, both can be swiveled or tipped together to get at deep corners. Spindle speeds range from 80 to 3600 R.P.M.

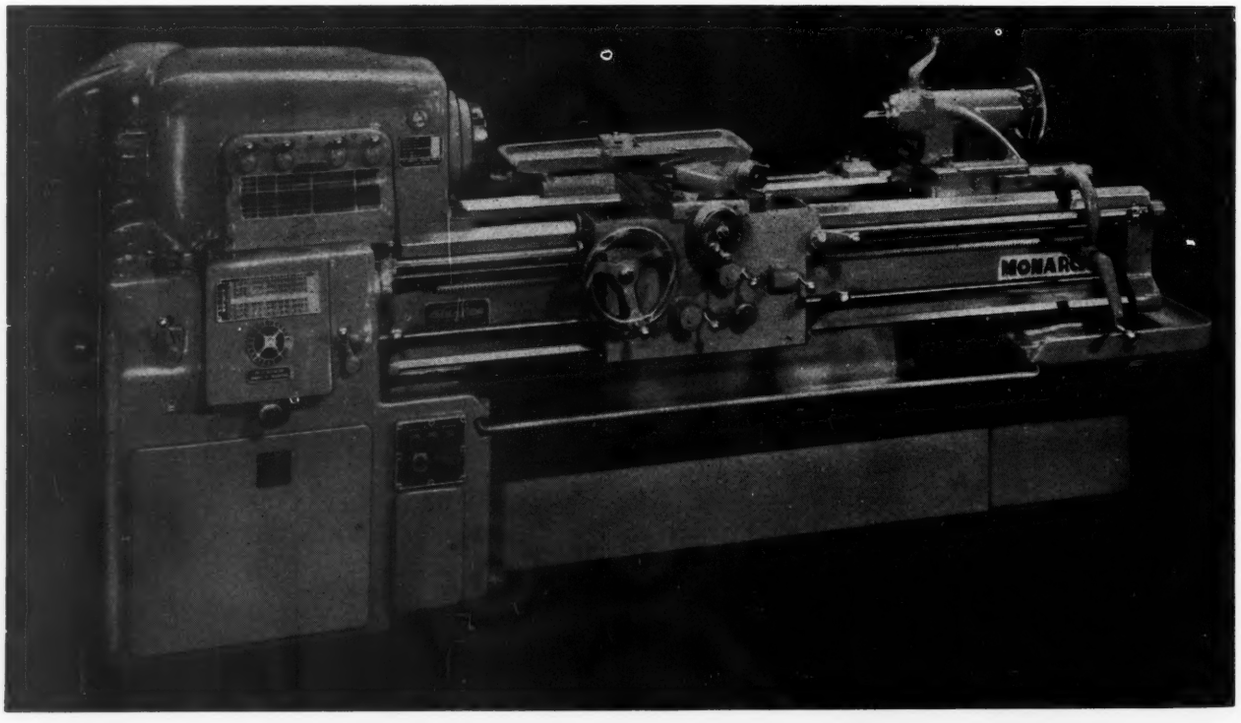
A new control cabinet, located at the operator's position, contains a panel of push-buttons and selector switches, each clearly marked as to the function it performs. Complete control of all motions, including speed and feed changes, is from this one centralized location. E-61

Monarch Engine and Toolmaker's Lathes

A new Series 60 line of engine and toolmaker's lathes designed to increase precision of operation and minimize maintenance is announced by the Monarch Machine Tool Co., Sidney, Ohio. These machines are available in 14-, 16-, and 20-inch sizes.

Both the gear-box and end gearing on these machines are totally enclosed, thereby preventing the entry of foreign matter into these vital mechanisms. This feature, combined with the use of automatic pressure lubrication, which is provided not only to the gear-box and end gearing, but also to the headstock, apron, carriage bearing on the ways, and compound bottom slide on the carriage, assures long service life and reduces maintenance.

Helical gears, made of hardened alloy steel with ground or shaved tooth contours, are used in the headstock. Owing to the extra width of the gear teeth, more tooth contact than is normally possible is obtained, resulting in more efficient transmission of power. Speed changes are made through heavy-sided jaw clutches, so that shifting is not a factor of gear wear. The gears are always in mesh. Accurate, rigid mounting and quick interchangeability of chucks, plates, and fixtures are secured through the use of an



One of a new series of engine and toolmaker's lathes developed by Monarch Machine Tool Co.

To obtain additional information on equipment described here, use Inquiry Card on page 225.

American standard Type D-1 camlock spindle nose. All bearings in this series are anti-friction type.

The tailstock is of the quick-clamping type, and the spindle is provided with a tang slot and a graduated scale. The lead-screw reverse is operated by a lever at the side of the apron, which is particularly advantageous when a large amount of thread chasing must be done. Stops on the reverse rod provide close control in both directions of carriage travel, either when threading or feeding.

All the lathes in the new series are especially suited for work based on the metric measurement system. Transposing end gears are available for use in connection with the standard English box, which provides pitches in millimeters and feeds in inches. A metric gear-box can be supplied on order, with English transposing gears, in which case threads are in inches and feeds are in millimeters. Module transposing gears may also be secured. E-62

"Protekto" Vise Jaws

Vise jaws known as "Protekto" have been developed by the Buiwitt Tool Co., 16535 Sorrento, Detroit 27, Mich., to hold machined parts without marring the surface. A tough, hard fiber block contacts the finished part and protects the surface. E-63

Landis Plain and Semi-Automatic Cylindrical Grinding Machines

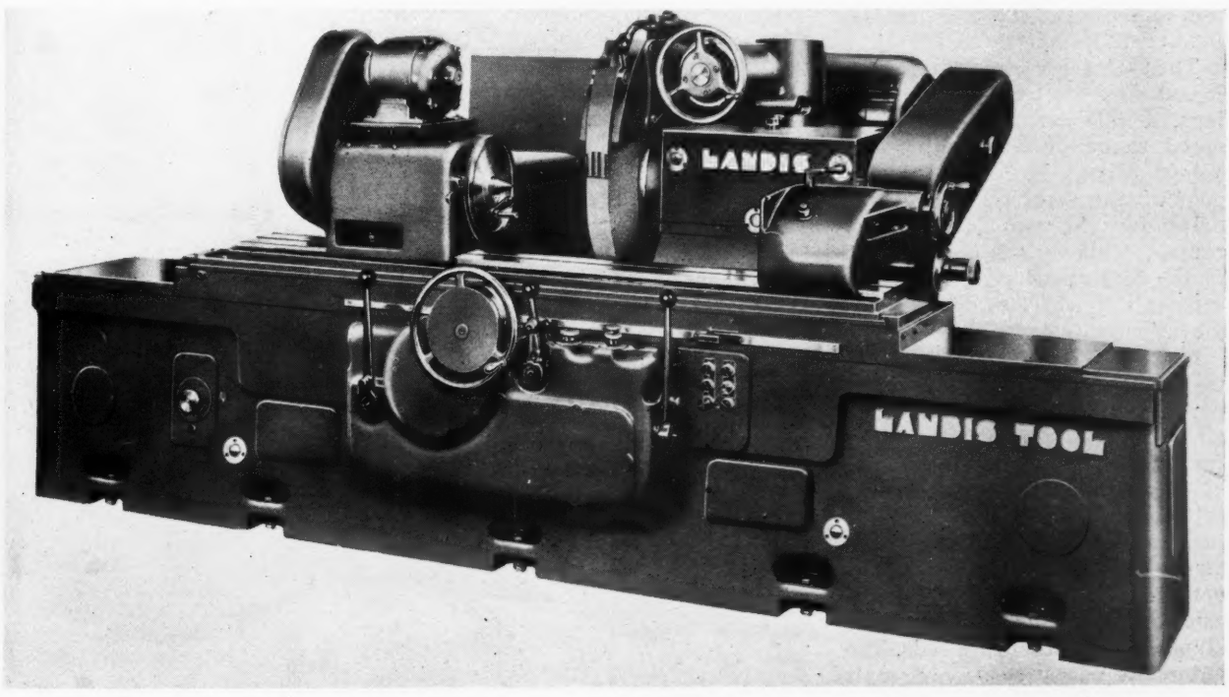
The Landis Tool Co., Waynesboro, Pa., announces a new line of plain and semi-automatic grinding machines with lengths between centers of 18, 36, 48, 72, 96, and 120 inches, available in both 10- and 14-inch swings. These grinders are intended to be used for medium-weight work-pieces that must be cylindrically ground to a high degree of finish and accuracy. Small-lot jobs, as well as steady high production, can be handled on this type of machine. Grinding operations for which the machine is suitable include straight cylindrical, taper, shoulder, and, with extra equipment, profile and angular grinding.

The 30-inch diameter grinding wheel is driven by either a 10- or a 15-H.P. motor. The headstock is powered by a 1-H.P. motor, with four work speeds ranging from 54 to 150 R.P.M. Both the wheel drive and the complete headstock drive are through V-belts.

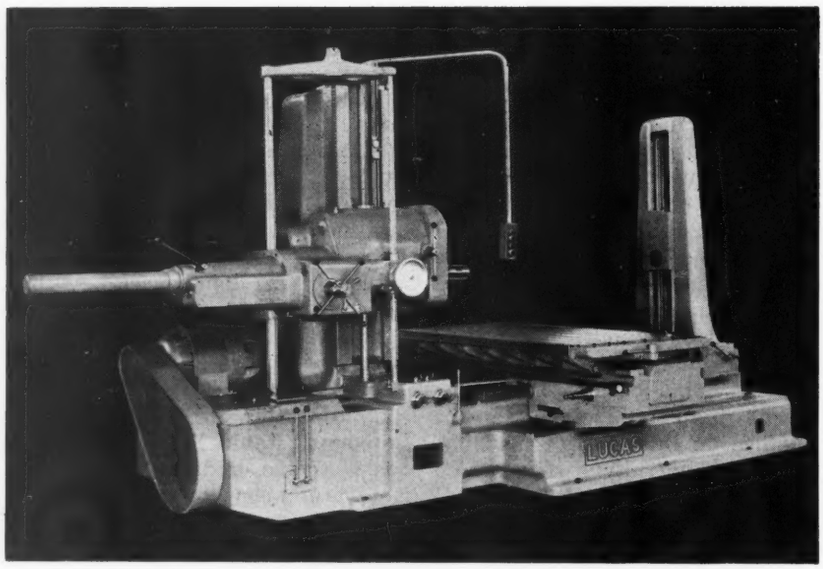
"Microsphere" bearings support the grinding wheel spindle. They are babbitt-lined, steel-backed, one-piece bearings, which are adjustable for clearance between spindle and bearing. With these bearings, running clearance is less than with conventional sleeve or cap bearings. Bearing lubricant is carried in a separate reservoir in the wheel-base casting.

Anti-friction bearings are provided for headstock spindles, wheel feed, and hand traverse. Either coarse or fine feed is available for the grinding wheel through a handwheel. A hydraulically actuated slow grinding feed for traverse grinding can be operated at each or either reversal point. This feed is adjustable for both rate and amount. Rapid hydraulic in-feed is available, and can be made to operate in conjunction with either the traverse grinding feed or the plunge grinding feed. For semi-automatic plunge grinding operations, a timer can be supplied, so that the operator will only have to load and unload the work. Traverse speeds range from 3 to 240 inches per minute. The two-speed hand traverse has a fast speed for set-up and a slow speed for hand-traverse grinding to shoulders if desired. Tarry control for traverse grinding operations is variable, and can be quickly adjusted from the front of the machine.

Telescoping covers are provided to protect the hand-scraped carriage ways, which are pressure-lubricated. A swivel table permits the grinding of tapered work. E-64



One of a new line of cylindrical grinders announced by the Landis Tool Co.



Lucas 4-inch redesigned horizontal boring machine

Lucas Improved Horizontal Boring Machines

The Lucas Machine Division of the New Britain Machine Co., Cleveland, Ohio has redesigned its 3- and 4-inch spindle series of horizontal boring, drilling, and milling machines. Among the changes made in the 4-inch machine illustrated is an extension of the bed at the left to support the motor and speed- and feed-gear boxes. The number and size of control handles have also been reduced, and all the controls have been color coded. Feed-unit selecting levers indicate the direction of feed, and the feeds can be combined.

The machine spindle is mounted in anti-friction taper roller bearings, and is driven at the high-speed range by a vibration-free V-belt drive. The large double gear on the spindle sleeve is the drive for the two lower speed ranges. This gear is out of mesh in the high-speed range, when it acts as a flywheel to dampen out vibration.

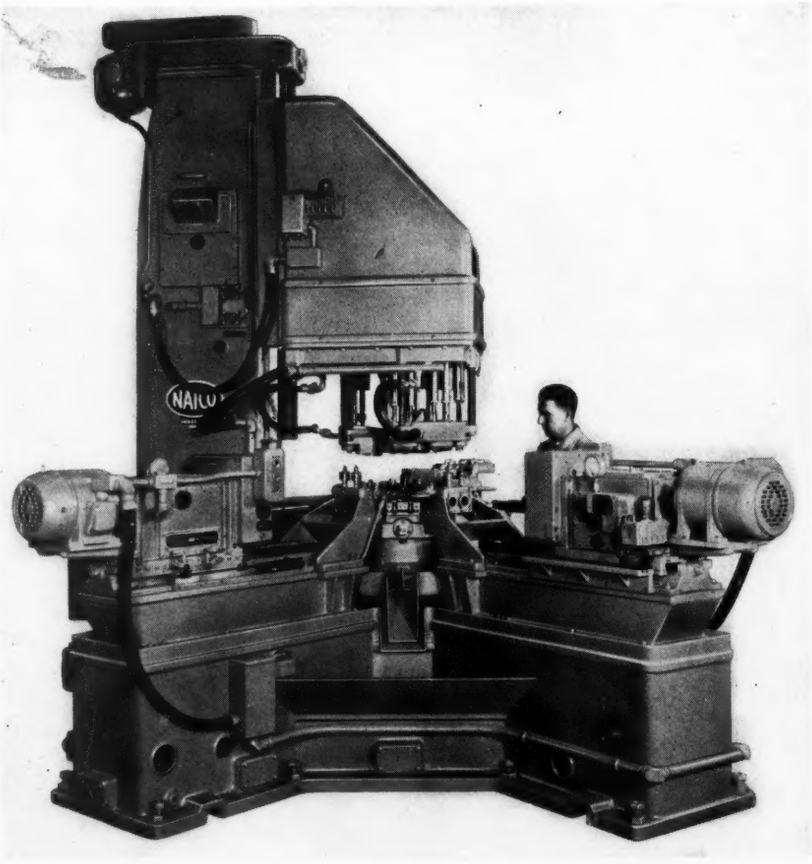
One of the main features of these machines is an automatic power positioning control, which allows an operator to set up a job for production work by the use of master rods, after which exact settings can be obtained without hand adjustment for each subsequent operation through regular operating controls. Short runs can be accomplished by using standard end measuring rods. The automatic power positioning unit enables all operations to be performed without jigs or fixtures.

These machines are built with lever controls for feed engagement and a movable electric pendent with buttons for remote control of stopping, starting, and jogging. The 4-inch machine is also available in an electrically controlled model, in which all motions are controlled remotely from a separate pendent which can be moved by the operator to any working position. E-65

Natco Four-Way Horizontal Drilling Machine

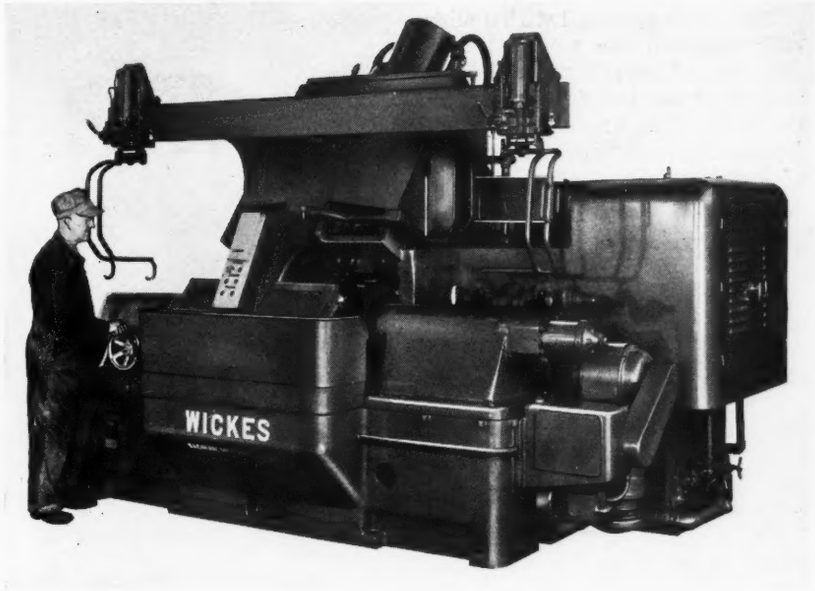
The new four-way horizontal drilling machine illustrated was developed by the National Automatic Tool Co., of Richmond, Ind., for machining and assembling refrigerator pistons. This Holesteel machine is made up of one vertical unit and head with standard column-wide ways; front and rear horizontal units and drill heads; and a special unit for pressing in tubes, cutting off, and inserting brazing wire.

The operations include drilling, core-drilling, facing, rough- and finish-reaming, chamfering, wire-brushing, cutting off and inserting brazing wire, and assembling the tube in the piston. The production rate is 248 pistons per hour. E-66



Holesteel four-way horizontal drilling machine developed by the National Automatic Tool Co. for machining and assembling pistons

To obtain additional information on equipment described here, use Inquiry Card on page 225.



Wickes automatic rough- and finish-turning center-drive crankshaft lathe

Wickes Crankshaft Lathe

A center-drive lathe designed for rough- and finish-turning all crankshaft main line bearings and ends simultaneously has been brought out by Wickes Brothers, Saginaw, Mich. This machine incorporates three sets of cross-slides which surround the crankshaft with cutting tools. Front and rear cross-slides carry the rough-turning tools and divide the tool load on the crankshaft during the checking, rough-turning and filleting operation. A third slide, which extends from spindle to spindle, approaches the crankshaft from the top and carries finishing tools which follow a few thousandths of an inch behind the rough-turning tools. When the roughing tools have turned the work to the required diameter, they slowly withdraw while the finishing tools finish-turn and fillet the bearings.

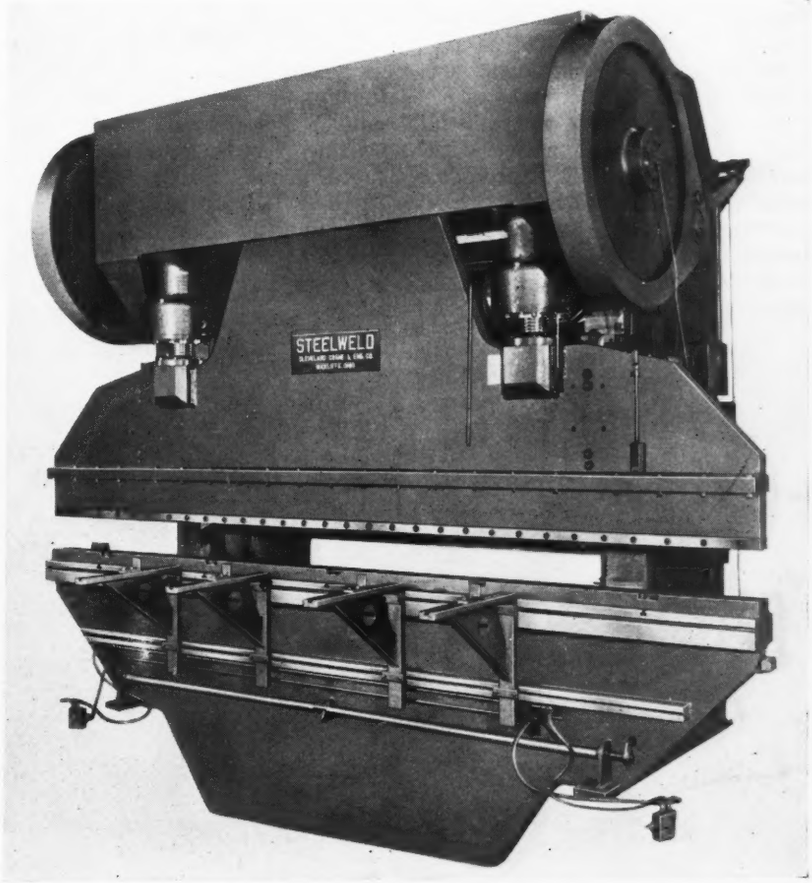
This new Model CF-4 lathe is furnished with a hydraulically operated tailstock, live centers, and an electrically operated chuck controlled by a push-button. The operator needs only to load the crankshaft and press a button on the control panel to start the automatic cycle.

The rate of production depends on the type of crankshaft and stock to be removed. On one leading automotive crankshaft, the production obtained from two of the older style crankshaft lathes with one operator was twenty-four crankshafts per hour for rough-turning only. Production of the same crankshaft on two of the new lathes with one operator is thirty-five per hour, including rough- and finish-turning.—E-67

Steelweld Bending Press Designed for Gooseneck Punch and Standard Dies

The Cleveland Crane & Engineering Co., 5413 E. 282nd St., Wickliffe, Ohio, has placed on the market a new Model M06-12 Steelweld bending press having a bending capacity of 500 tons, which will bend 3/8-inch plate up to 20 feet 6 inches in length. The machine is designed to take a special large gooseneck punch, and for this reason has a shut height of 30 inches. However, the ram is provided with an extension as shown in the illustration, which brings the shut height down to 16 inches, permitting the use of standard dies when desired.

The over-all height of this machine is 17 feet 1 inch, with 2 feet 6 inches below the floor level. The bed and ram have a length of 20 feet 6 inches, which includes a 3-foot extension on both ends. The depth of the press is 9 feet, and the distance between housings is 12 feet 6 inches. An extra deep 18-inch throat is provided, as on all large Steelweld presses.



Steelweld bending press with special features, built by the Cleveland Crane & Engineering Co.

To obtain additional information on equipment described here, use Inquiry Card on page 225.

The machine has a 6-inch stroke, with two speeds of seven and twenty strokes per minute. The clutch is air-operated, and controlled by two foot-operated valves. The ram can be reversed at any point in the stroke.

The bed is provided with a slide rail on which are mounted four brackets, adjustable up and down and along the bed for supporting the work. The brackets have adjustable stops for different widths of metal. E-68

Cincinnati Filmatic Gap Grinding Machine

A center type grinding machine with a gap table, designed to handle locomotive piston-rods and similar parts requiring additional swing for a large diameter of short length, has been announced by Cincinnati Grinders Incorporated, Marburg Ave., Cincinnati 9, Ohio. These machines have a nominal 16-inch swing, 40 inches over the gap, and are built in four lengths—96, 120, 144, and 168 inches.

In general, they have the same design features as the Filmatic 14- and 16-inch plain grinding machines. The grinding-wheel spindle runs on Filmatic bearings —a segmental construction that develops high-pressure wedge-shaped oil films between the segments and the spindle. These bearings automatically adjust themselves to variations in forces created by the grinding action. Spindle bearing diameters are super-finished to a surface accuracy of less than 1 micro-inch. Lubrication is automatic, with circulating filtered oil. It precedes spindle rotation, and initiates the starting through a pressure switch. Should the lubricating system fail, the grinding wheel motor automatically stops.

The table is traversed by a rack and pinion through a motor drive with electronic control. Traverse rates are infinitely variable over a range of 3 to 120 inches per minute. This type of drive provides a smoothness and flexibility that is comparable to hydraulic traverse.

The electrical system for these machines provides automatic acceleration and deceleration of the table at reversal, thereby eliminating shock. No mechanical clutches are employed. Tarry at each end of the table stroke can be independently adjusted for a time delay of 0 to about 18 seconds. Coolant flow and headstock spindle rotation can be stopped and started independently or in unison with the table traverse. This is also a function of the electrical system.

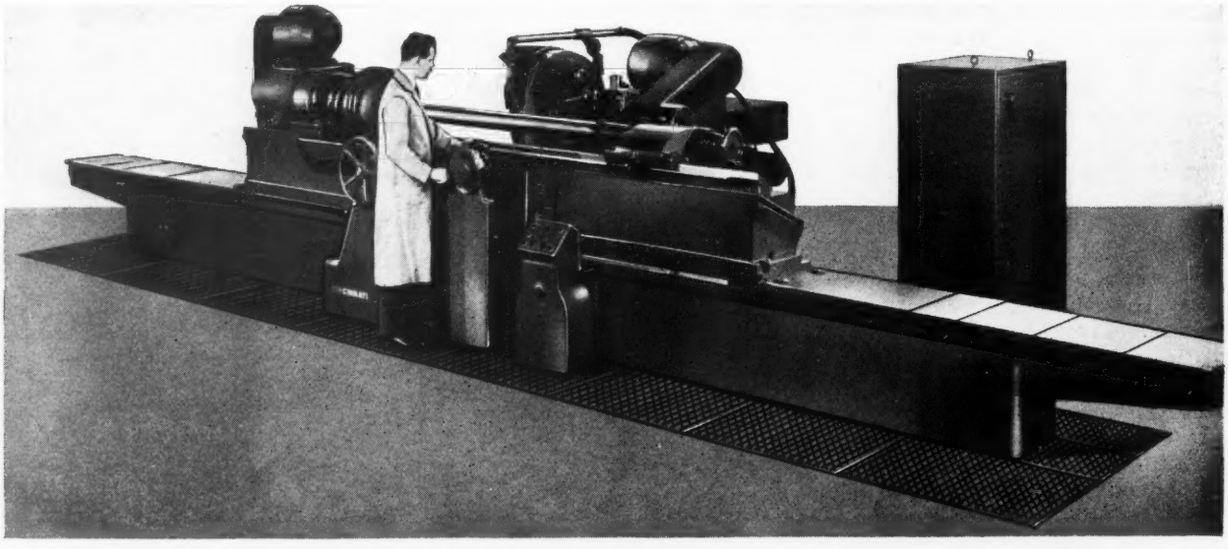
The headstock is a motor-driven unit, and there is a No. 15 B & S taper hole in the spindle. The unit has an exceptionally long bearing on the table. Spindle speeds are infinitely variable from 20 to 72 R.P.M. Matched V-belts and precision silent chain are employed to smoothly transmit power from the motor to the faceplate. E-69

Portable silicone-insulated welder made by the General Electric Co.

General Electric Silicone-Insulated Welder

A new silicone-insulated, portable, alternating-current welder (6WK20H series) has been announced by the General Electric Co., Schenectady 5, N. Y. This welder is 12 by 17 inches in cross-section and 23 inches high, which permits it to be utilized in restricted space where larger welding units cannot be used. Its weight is 154 pounds, and it has a current range of from 30 to 250 amperes. Electrodes from 1/16 to 3/16 inch in diameter are accommodated.

The standard model contains a primary switch and is designed for operation on 220 volts, but models are available for operation on 440 volts with or without power factor capacitors. E-70



Filmatic 16-inch gap grinding machine built by Cincinnati Grinders Incorporated

To obtain additional information on equipment described here, use Inquiry Card on page 225.

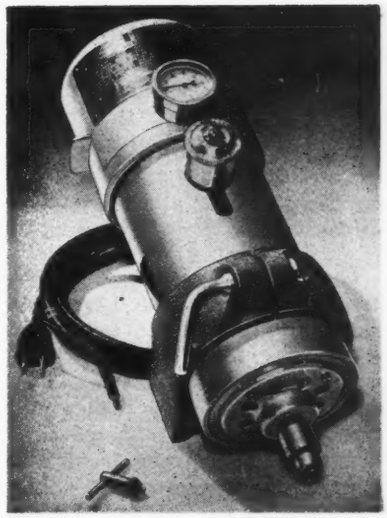
Kearney & Trecker Plain and Universal Milling Machines

A new line of general-purpose knee type milling machines, in plain and universal styles, has been announced by the Kearney & Trecker Corporation, 6784 W. National Ave., Milwaukee 14, Wis. These machines, designated Model CK, are built in five sizes, Nos. 2, 3, 4, 5, and 6. The principal features include newly designed columns, which are heavier than previous models by 1000 to 1200 pounds; spindle-mounted flywheel with three-bearing support; and heavy-duty table feed-screw, 2 inches in diameter, with extra long bronze nut and positive backlash eliminator.

Horsepower ratings have been increased, the range being from 10 to 25 H.P. Independent motor drives are employed for spindle and for feed and rapid traverse. The spindle and feed motors are interlocked with a positive automatic safety control for overload conditions, thereby preventing cutters from stalling in the cut.

The Nos. 4, 5, and 6 machines are equipped with double-duty spindle noses. The conventional No. 50 National standard spindle nose has a No. 60 heavy-duty driving flange integrally forged with it to permit improved cutting efficiency when large-diameter face mills, or flange type arbors for large-diameter side and slot milling cutters are used. An optional feature on the Nos. 2 and 3 sizes is the "Mono-Lever" control for table feed and rapid traverse. This is standard on the Nos. 4, 5, and 6 machines. Feed changes from 3/8 inch to 90 inches per minute are provided on all machines, and there are twenty-four spindle speed changes. The speed range on the Nos. 2 and 3 machine is 15 to 1500 R.P.M., and 13 to 1300 R.P.M. on Nos. 4, 5, and 6. Gear clashing in changing speeds is eliminated by an automatic "protecto-mesh" controlling system.

Automatic lubrication is provided through a forced flood system in the column and knee and a positive metered, pressure pump system for the table, saddle, and knee ways and the table feed assembly. E-71



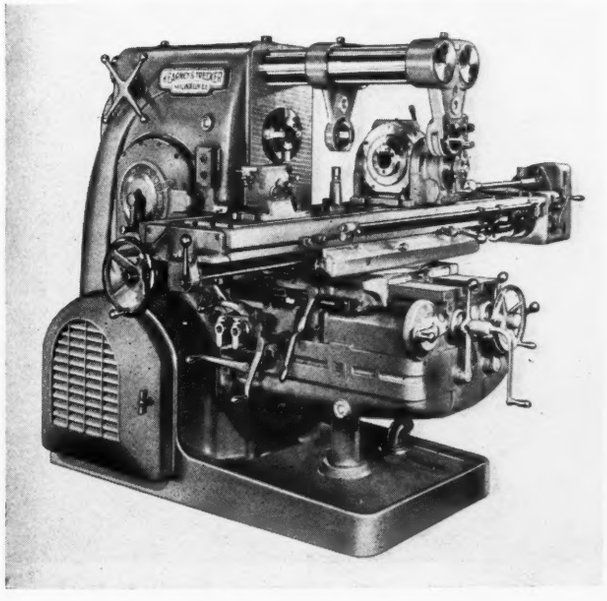
Dumore automatic drill head, which combines a motor, chuck, and air compressor in one compact unit

Dumore Automatic Drill Head

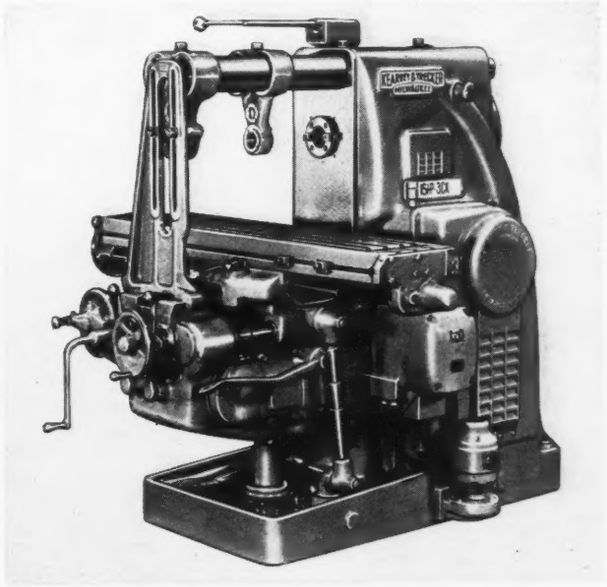
An automatic drill head has been developed by the Dumore Co., Racine, Wis., that is applicable for drilling holes of 0.0135 to 0.1800 inch diameter in ferrous or non-ferrous metals, plastic, wood, etc. The new drill head consists of a Dumore motor with double-end armature shaft having a No. 0 precision Jacobs chuck mounted on one end and a rotary vane air compressor on the other end. The motor supplies the power for drilling, while the air compressor advances the drill at a predetermined speed and pressure. This compact unit maintains uniform drilling pressure without the need of separate air equipment, and operates from any convenient electrical outlet.

The speed of the universal motor is controlled by the load of the rotary vane compressor, which acts as a speed governor. Thus, the drill head operates at working speeds varying from 2500 to 7500 R.P.M., depending on the pressure exerted on the drill by adjusting the air pressure and feed regulator.

The depth of stroke ranges



Kearney & Trecker 25-H.P. universal milling machine



Kearney & Trecker 15-H.P. plain milling machine

from 1/32 inch to 1 1/8 inches, and can be controlled to within 0.004 inch by adjustable stop-nuts. Forward movement of the drill is slowed at the break-through point by increasing the pressure of a spring return, thus minimizing drill breakage and heavy burring. For drilling holes of a depth greater than five drill diameters, the unit can be operated manually. E-72

Federal 35-Ton Press

The Federal Press Co., Elkhart, Ind., announces an important addition to its line of presses. The new press, known as the No. 44, has a capacity of 35 tons. The standard stroke is 6 inches and the standard shut height 10 inches, but any stroke from 1 to 12 inches can be provided, and a frame extension or added shut height from 1 to 10 inches over standard is available. The throat depth is 11 1/2 inches. This press has a 33- by 21-inch bed area, and a ram face 24 inches long right to left, by 8 inches long front to back.

Features of the new machine include a removable ball-seat, round type ram clamp and a rear-operated reclining mechanism. In addition, the new press is equipped with Timken bearings, non-repeat clutch (standard or multi-pin) mechanism, and a knock-out bracket. E-73

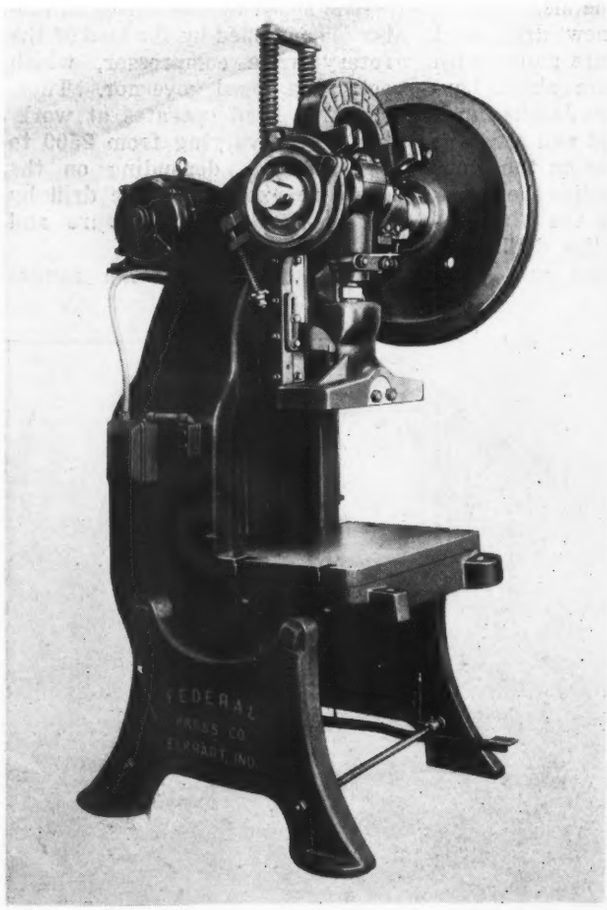
"Swing-Cut" Wet Cutting Machine

A new model has been added to the line of "Swing-Cut" metal cut-off machine built by the Stone Machinery Co., Inc., 540 Fayette St., Manlius, N. Y. This machine is fully equipped for wet cutting, with recirculating pump, tank, hose connections, and removable splash guards. The flow of cutting fluid is controlled by the action of the cutting head.

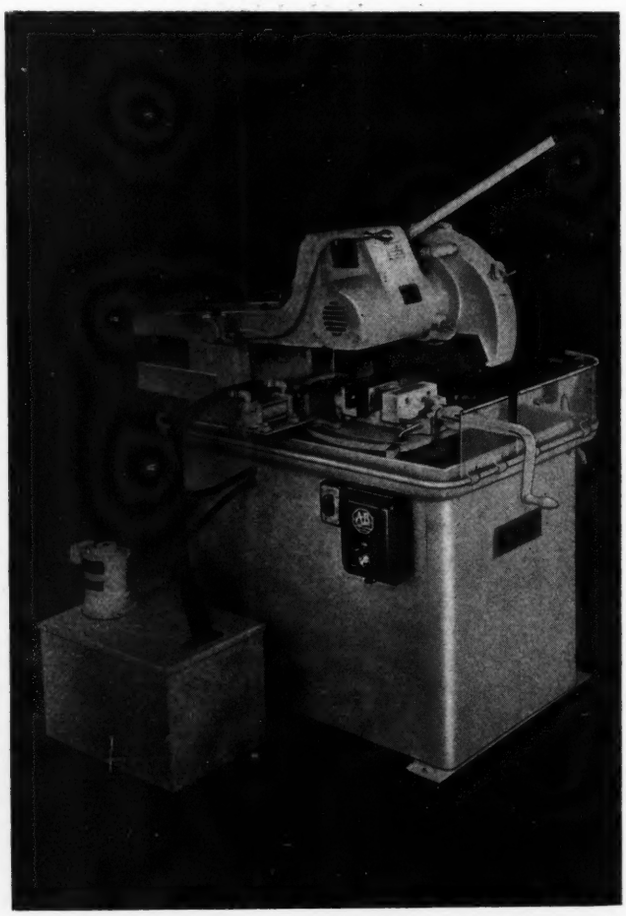
An improved method of adjusting for depth of cut has been added in the form of a wheel depth control arm, actuated from the operator's normal position. Also added is an adjustable work-stop, which can be used for cutting multiple pieces up to 24 inches in length. The splash guards are movable for protection when cutting at angles. A hand- or foot-controlled air-actuated self-centering vise is available. E-74

Porter Square and Oblong Precision Punches

New button-head, interchangeable, precision punches in standardized square and oblong series have been announced by Porter Precision Products, P.O. Box No. 99, Cincinnati 31, Ohio. The new punches, manufactured from water hardening tool steel, are available in semi-finished condition, and are ground and finished to customer specifications. They can also be supplied in high-speed and high-chrome, high-carbon steels. E-75

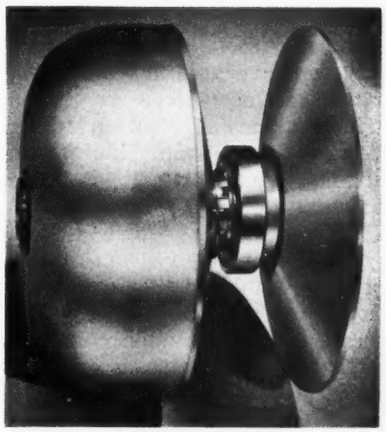


New 35-ton press that has recently been added to the line of the Federal Press Co.



New model "Swing-Cut" metal cut-off machine built by Stone Machinery Co., Inc.

To obtain additional information on equipment described here, use Inquiry Card on page 225.



Automatic variable-speed clutch pulley controlled by engine speed

Centrifugally Operated Automatic Clutch

A variable-speed clutch pulley that is automatically controlled by the engine speed and makes possible infinite gear ratio changes on any kind of machine on which a variable-speed belt can be used has been developed by Charles H. Miner and the Driv-Way Lite Co., P.O. Box 2850, Denver, Colo.

The new automatic clutch is centrifugally operated. In one of the two pulley halves of the clutch, which are mounted on a central shaft connected to the engine, are several steel balls. When the speed of the engine is increased, the centrifugal force of the balls pushes the pulley halves together, thereby raising the position of the belt on the pulley and automatically changing the engine from a low to a high speed ratio.

The opposite pulley on which the belt revolves is operated by spring action. When the pulley belt is in the high position between the closed halves of the driving pulley, it is in the low position on the secondary pulley and the engine is in high speed. When the opposite is true, the engine is in low speed.

The most important feature of the new automatic clutch is its simplicity. Reduction or acceleration of starting and running speeds can be easily obtained by inserting larger or smaller balls, by using aluminum rather than steel balls, or by changing the number of balls. E-76

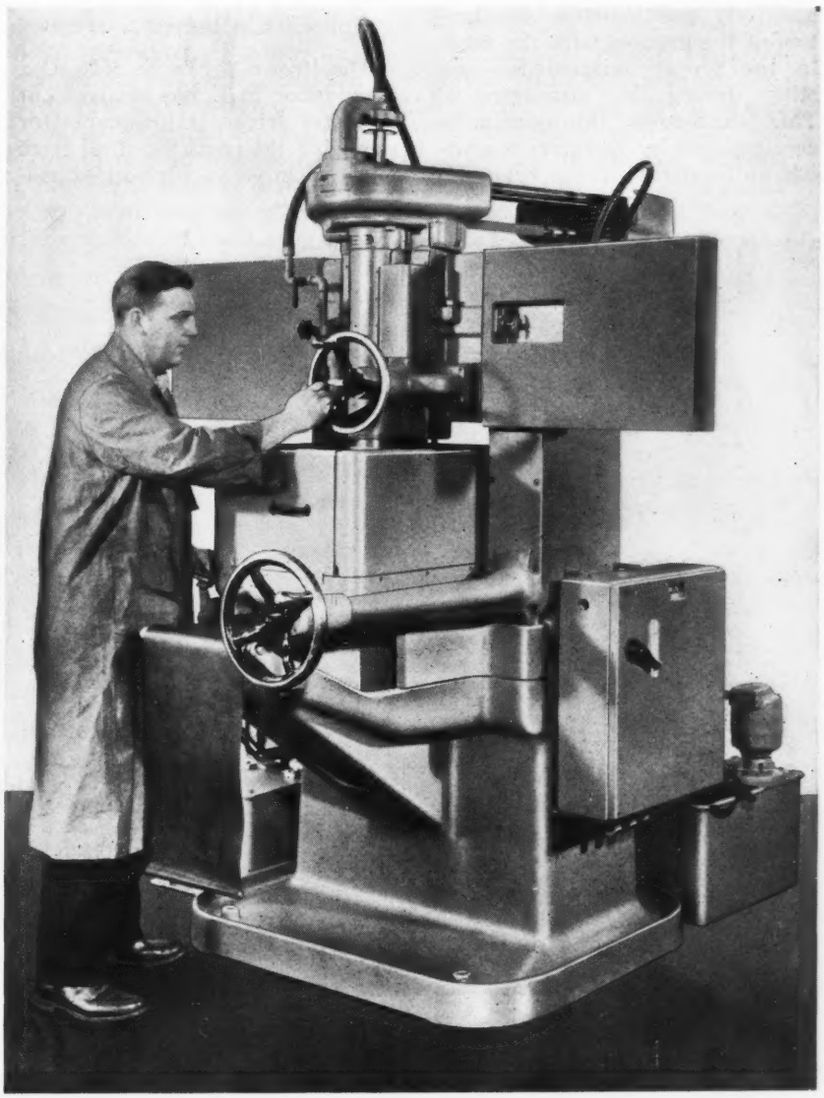
Pratt & Whitney Vertical Die and Surface Grinder

Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn., announces a grinder that is specifically designed for facing new die-blocks, reconditioning dulled impression edges, and preparing worn dies for resinking, but is also suitable for regular surface grinding.

Operating like a vertical profiler, it can be used for finishing flats around irregular reliefs, and is especially suited for precision step grinding. Surface finishes of 1 1/2 to 2 micro-inches are produced without the need for subsequent lapping or polishing and with a minimum breaking down of cutting edges. Sufficient clearance is provided to permit grinding between guide pins on blanking punch and die halves. Thus time is saved in resurfacing dulled impression edges by eliminating much of the disassembly and reassembly time.

The machine is built in two sizes, with table capacities of 16 by 24 inches and 36 by 42 inches. The 16- by 24-inch machine is equipped with three spindle speed changes, which adapts it for grinding carbide or tough die steels. The speeds are especially suited for 3- and 5-inch diameter grit cup-wheels and diamond cup-wheels. The table hydraulic drive has a variable feed range of 1 to 20 feet per minute.

The 36- by 42-inch grinder accommodates the larger sizes of blanking punches and dies and forging dies. A 10-inch ring wheel is used on this machine with a spindle speed of 1750 R.P.M. The table hydraulic power feeds for this size machine range from 1 to 40 feet per minute. E-77



Vertical die and surface grinder developed by Pratt & Whitney Division Niles-Bement-Pond Co.

To obtain additional information on equipment described here, use Inquiry Card on page 225.

Sheffield Radial Internal Clearance Measuring Instrument

A gaging instrument has been developed by the Sheffield Corporation, Dayton 1, Ohio, for accurately measuring radial internal clearance of ball and roller bearings on a production basis. Readings are direct, without the use of masters, and are positively repetitive.

The bearing is placed on a horizontal arbor of a size corresponding to the internal diameter of the inner ring, with the outer ring floating both axially and radially. Two simple operations of a foot-pedal cause the bearing to be loaded successively upward and downward. The movements of the outer ring are shown on a "tenth" dial, and the difference between the two readings represents the amount of radial play with the bearing in that position.

This instrument is said to be the only one in which the balls are positively positioned at the bottom of the grooves with the races in the proper relation to each other during the measurement. This "shakedown" into position is accomplished by vibrators operating automatically for a brief adjustable cycle as the load is applied upward and downward.

The indicator is mounted on a ball slide having a pressure arm extending along a slot at the top of the arbor. As the bearing is placed on the arbor a snap gage effect is achieved, resulting in a positive and accurate measurement of the true distance between the inside diameter and the outside diameter of the outer ring.

The instrument is flexible enough to check a great variety of sizes and styles of bearings. Upper and lower measuring load members are easily adjusted to accommodate bearings having internal diameters ranging from 3.2 to 50 millimeters, inclusive, or a maximum of 5 inches outside diameter of outer ring. E-78

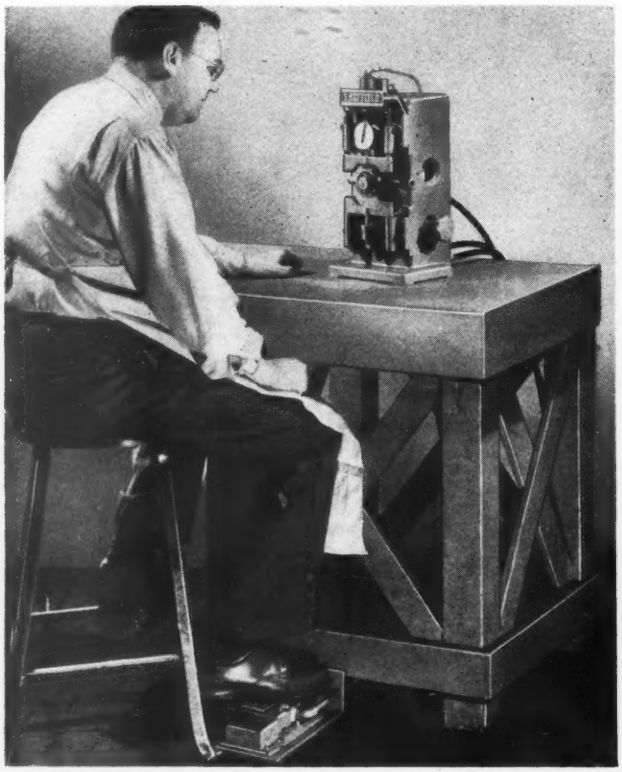
Brown & Sharpe Vapor Collector

The Brown & Sharpe Mfg. Co., Providence, R. I., has brought out a motor-driven attachment for removing the particles of oil from mist produced in high-speed machining operations where oil is used as a coolant. These vapor collectors are used in connection with such operations as thread grinding, carbide tool grinding, formed-wheel grinding, high-speed turning, and many automatic screw machine operations.

The attachment consists of a 1/4-H.P. motor-driven fan mounted on a tank. Oil-laden air is blown into the tank, where it disperses in an expansion chamber, so that it slowly spreads over the whole area of the three outlet filters. In these filters, the oil is collected on the renewable filter pads where it drains to the base of the tank. A drain-cock provides for removing the oil for re-use. If desired, the reclaimed oil can be piped directly to the coolant tank of the machine. E-79

Logansport Air Control Valves and Improved Air Regulator-Filter-Lubricator

New two- and three-way as well as four-way, two-position, 1/4-inch port air control valves, designed for either side or base mounting, are announced by Logansport Machine Co., 810 Center



Gaging instrument developed by the Sheffield Corporation for accurately measuring radial internal clearance of ball and roller bearings

Vapor collector for reclaiming coolant oil dispersed in mist during high-speed machining operations, brought out by Brown & Sharpe Mfg. Co.

To obtain additional information on equipment described here, use Inquiry Card on page 225.

New two- and three-way air valve made by the Logansport Machine Co.

Ave., Logansport, Ind. Both types consist of a single valve body to which various accessory parts may be added to attain any of five types of operation.

The two- and three-way valves are made for remote control of bleeder- and pilot-operated master valves, control of single-acting air cylinders, and other uses. They are manufactured with only three ports, one of which can be plugged to make a two-port valve. Operation may be by means of push-button, toggle, cam, air cylinder, and foot-pedal.

The four-way, two-position valves can be used for remote control of pilot-operated master valves where two three-way pilot-operating valves would otherwise be required.

An improved type of air regulator-filter-lubricator has also been brought out by the company. The new unit has a piston type instead of a bellows type regulator, and the former porous-metal filtering element has been replaced by a synthetic element. Instead of being attached by means of small screws, the filter cover and regulating valve now screw into the main body of the unit. E-80

Colmonoy-Tipped Chuck Jaws

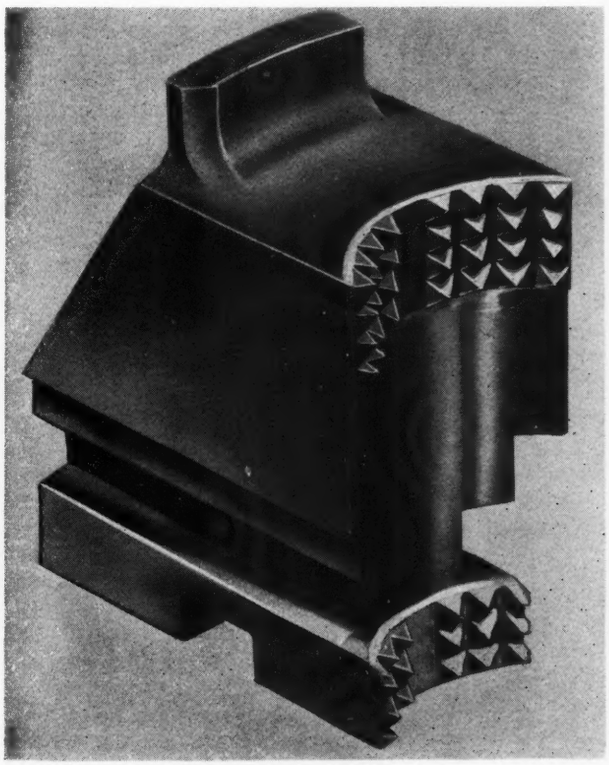
Diamonds and Tools, Inc., 19345 John R St., Detroit 3, Mich., have placed on the market chuck jaws with Colmonoy cast inserts. These inserts provide long life and a high degree of accuracy, and when they become worn, new ones can be easily put in place. As the Colmonoy is silver-soldered to the jaw, it is only necessary to heat the jaw to remove the old insert and replace it with a new one. Another important advantage is the elimination of heat-treating.

New Logan R-F-L unit for regulating air pressure, filtering and lubricating air

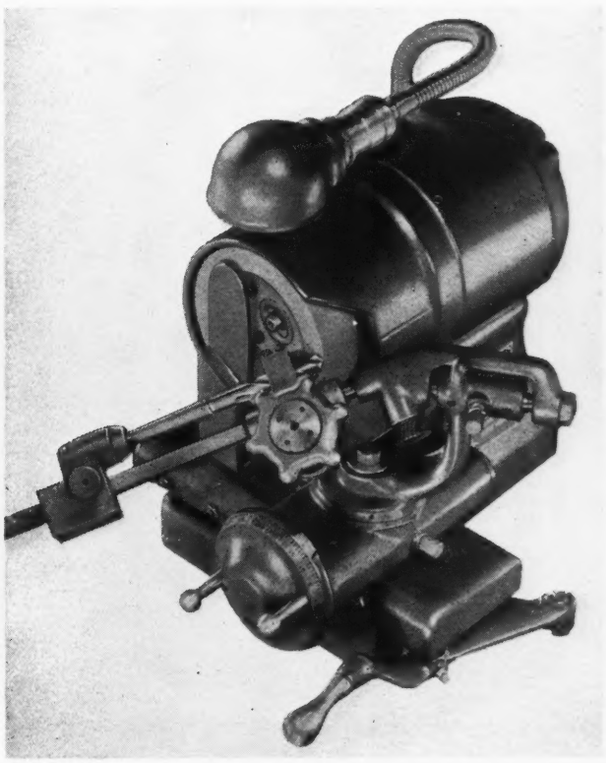
Either complete jaws with "Colmonoy" inserts ground in place or separate inserts can be obtained. E-81

Sellers Improved Drill Grinder

An improved drill grinder equipped with a ball-bearing slide, ball-bearing swing frame, and quick adjusting tail-center has been brought out by the William Sellers Division of Consolidated Machine Tool Corporation, Rochester 10, N. Y.



Chuck jaws with Colmonoy cast inserts

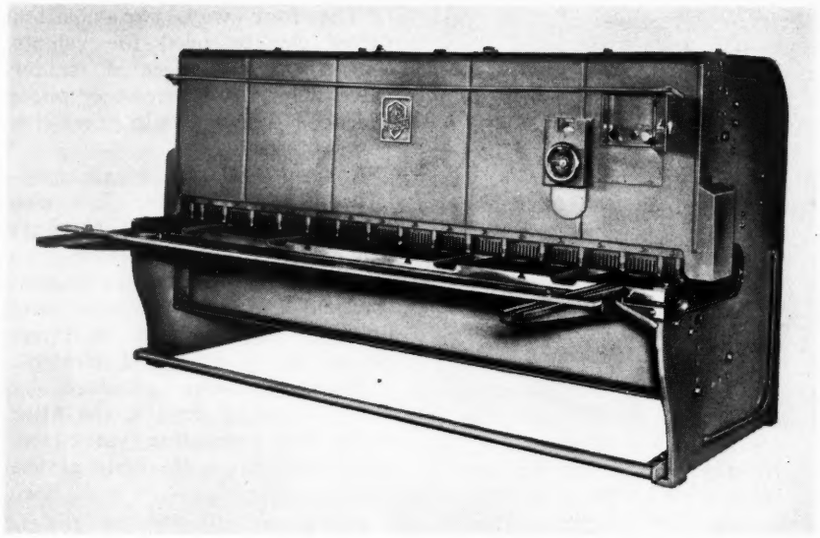


Sellers improved drill grinder

This No. 1G machine produces the Sellers drill point on one or any quantity of drills in sizes as small as 0.028 inch (No. 70) and up to 1/2 inch in diameter. It provides theoretically correct drill lips ground with the same inclination to the drill's axis, of equal length, and with proper clearance at both center and periphery. Additional capacity is obtained by means of a special attachment that permits grinding drills from 1/2 to 1 inch in diameter. E-82

Johnson Hydraulic Shear

The new sheet-metal squaring and slitting shear illustrated, which is manufactured by the Johnson Machine & Press Corporation of Elkhart, Ind., uses hydraulic power to avoid overload. It is known as the Hydra-Shear. The hydraulic feed causes the knife to pause the instant it engages the stock, and then pass through at a constant calibrated speed.

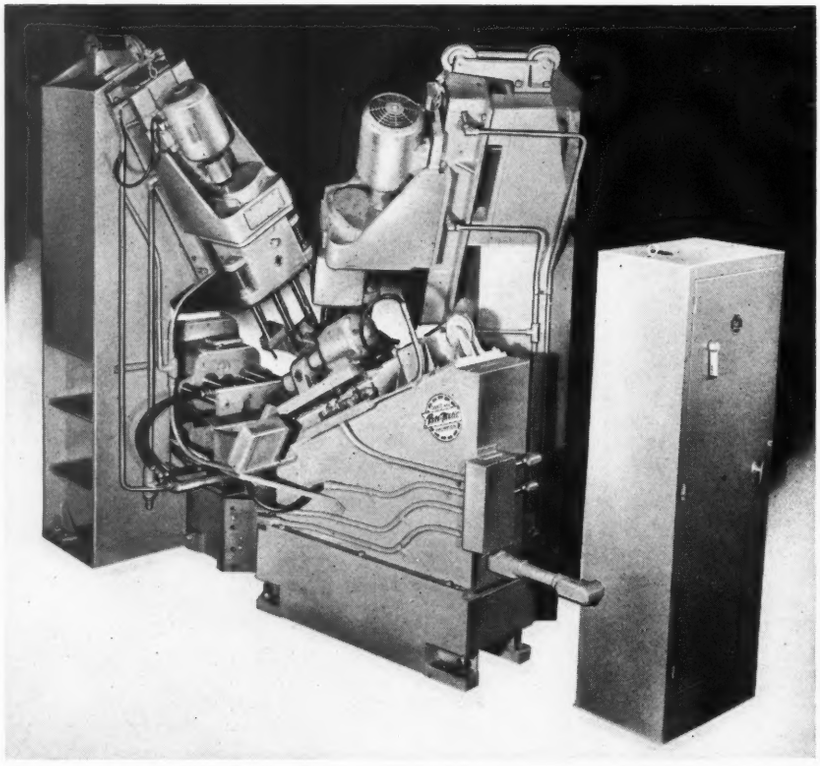


Johnson hydraulic sheet-metal squaring and slitting shear

The machine is a completely self-contained unit, with all working parts fully enclosed. It requires no special mounting. Twelve sizes are available for stock ranging from 10-gage to 5/16 inch. E-83

Davis & Thompson Multiple-Hole Drilling Machine

Four Roto-Matic power heads, each having independent hydraulic feed and spindle speed change-gears are incorporated in a machine developed by Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis., for drilling twelve holes that vary in diameter from 13/32 to 21/32 inch in plow frogs. The rate of production is 120 pieces per hour.



Davis & Thompson drilling machine with four Roto-Matic power heads for drilling twelve holes of various diameters in plow frogs

Because of the location of the drilled holes, an electrically interlocked feed and return stroke are provided to permit one head to move into position behind another only after its interlocked unit is in position.

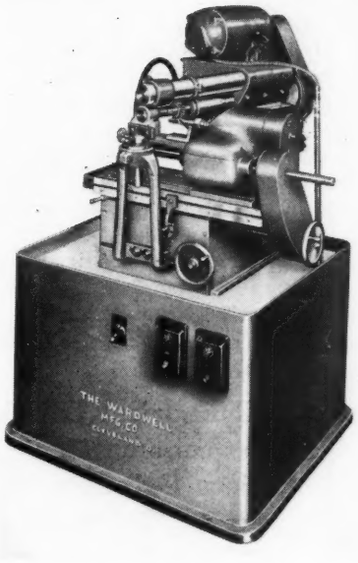
Clamping of the work-piece is accomplished through the use of a single hydraulic clamping fixture. A mechanical locking feature safeguards against unclamping due to hydraulic failure. The machine is electrically controlled by push-buttons and the drilling units are electrically sequenced, which permits rapid traverse of the drills only after the work-piece is properly clamped. E-84

Wardwell Hydraulic Automatic Flute Milling Machine

A hydraulic automatic machine designed for fast, accurate milling of spiral and straight flutes on counterbores, countersinks, taps and reamers, spiral or end milling cutters, and other special work where a dividing head is required has been announced by the Wardwell Mfg. Co., 3167 Fulton Road, Cleveland 9, Ohio.

The spindle is mounted in a removable quill on a double row of anti-friction bearings, with provision for expansion and has a No. 9 B & S taper hole, so that milling cutter arbors on end-mills

To obtain additional information on equipment described here, use Inquiry Card on page 225.



Wardwell hydraulic automatic flute milling machine

can be used. It is fitted in a housing that is mounted on a cross-slide swivel base on top of the vertical slide. The spindle housing can be swiveled to any angle up to 45 degrees for milling spiral flutes. The spindle is driven through a double V-belt by a 1 1/2-H.P. motor drive having four speeds.

Indexing is automatic, and an automatic locking device is provided for the work-arbor. Spiral milling is accomplished through a train of gears at the end of the work-spindle, connected to the lead-screw in the table. These are interchangeable to suit the lead of spiral desired.

Small cutting tools from 1/8 inch to 4 inches in diameter with spacing from two to forty flutes can be milled in this machine. E-85

Beatty "Guillotine" Beam and Shape Punch

The "guillotine" punch illustrated has been designed by the Beatty Machine & Mfg. Co., Hammond, Ind., to punch plates or webs of beams, channels, and angles. It can be furnished with special overhang die-blocks for punching flanges of small beams and channels. The machine is equipped with air-operated clamps that operate against adjustable fixed stops, and gag operating levers for operation from the right side.

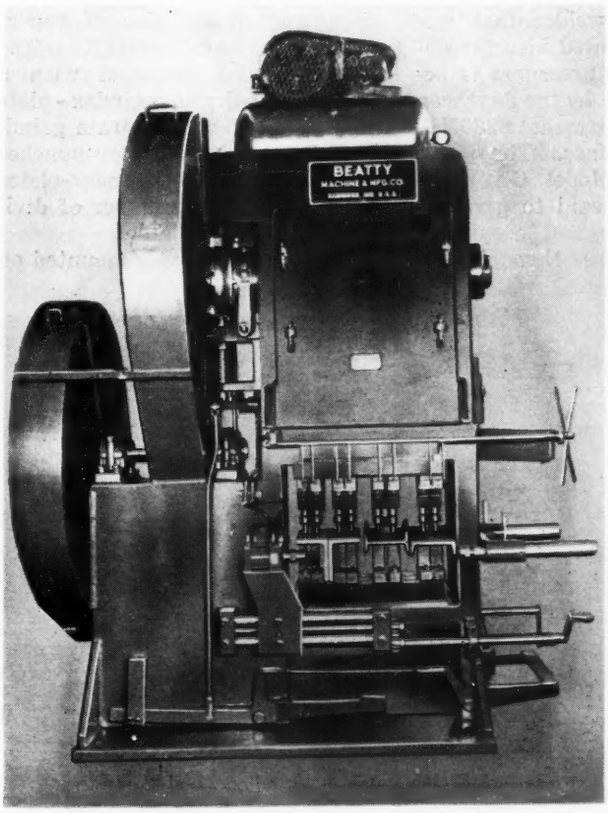
The capacity of the machine is 200 tons, and it is capable of punching four 15/16-inch diameter holes through 3/4-inch plate. The stroke is 2 1/2 inches; size of table, 32 by 21 inches; and die space 26 inches. E-86

Hannifin Hydraulic "Han-D-Press"

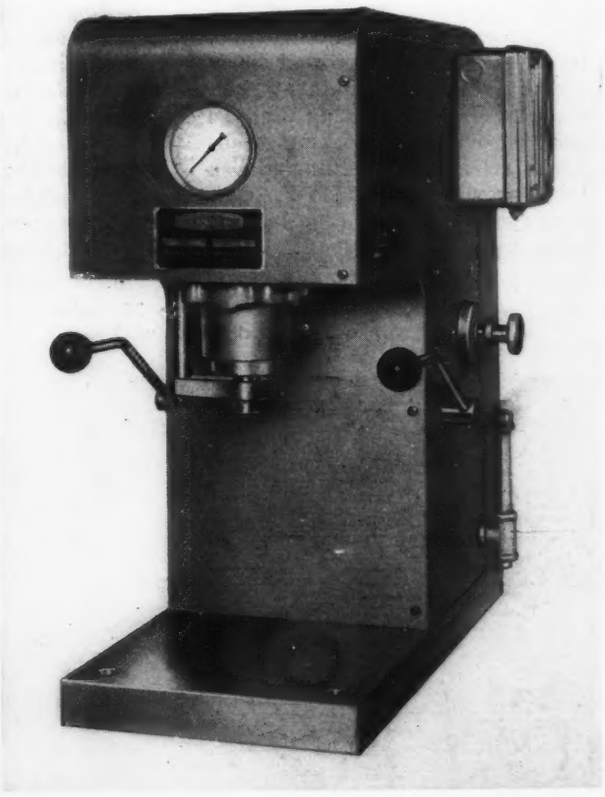
A hydraulic press has been added to the line of air-operated "Han-D-Presses" built by the Hannifin Corporation, 1110 S. Kilbourn Ave., Chicago 24, Ill. The new "Han-D-Press" has been developed for production operations such as staking, marking, broaching, punching, riveting, and press-assembly. It is available in 1- and 2-ton sizes.

The new hydraulic machine is equipped with a 1 1/2-H.P., 1800-R.P.M. motor, available in any standard voltage, which operates a constant-volume pump with a capacity of 3.3 gallons per minute. A relief valve makes it possible to adjust the maximum ram pressure shown on the gage to any setting from 10 per cent of capacity to full rated capacity.

The stroke of the new press is 6 inches, and the gap is 10 inches. E-87



Beatty 200-ton "guillotine" punch designed to punch plates or webs of beams, channels, and angles



Hannifin hydraulic "Han-D-Press" for staking, marking, broaching, punching, riveting, and other operations

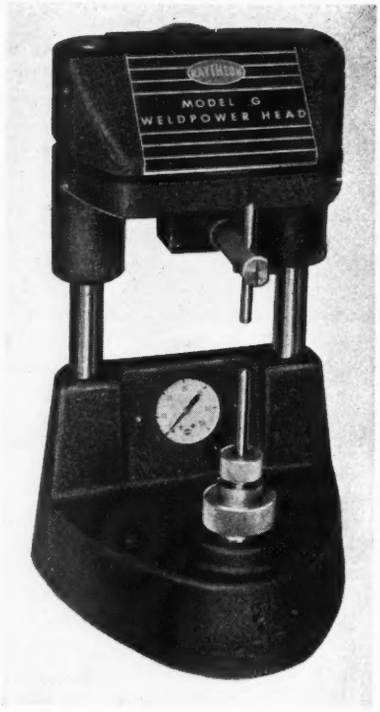
To obtain additional information on equipment described here, use Inquiry Card on page 225.

Denison Hydraulic Index-Table

The Denison Engineering Co., 1160 Dublin Road, Columbus 16, Ohio, is now making a 33-inch diameter automatic index-table with a 24-inch work circle that can be used on the company's 35-ton Multipress and on other makes of equipment. It is hydraulically powered, provides variable speeds for any preselected indexing rate from 10 to 70 indexings per minute, and positions the dial with an accuracy of plus or minus 0.002 inch. When installed on the Multipress, it is driven by the pumping unit of the press through the control system. The table can also be operated by a small auxiliary pumping unit when used with other than hydraulic equipment.

The table, which is completely self-contained, is available with either six or twelve stations. It operates in positive sequence with the action of the press ram through the control system of the hydraulic power unit, providing positive interlock, so that the ram cannot descend while the table is in motion and the table will not rotate until the ram has completed its cycle.

An important feature of this new index-table is said to be a positive locking device that holds the dial firmly in place at each station. The connecting linkage between driver and locking mechanism releases the locking pin as table prepares to rotate through each cycle. Speed can be changed while table is in motion. E-88



"Weldpower" head which utilizes a built-in metallic-bellows air storage system to provide electrode pressure

Raytheon Bench Spot-Welder

A bench spot-welder that employs a new patented idea for obtaining electrode pressures is being manufactured by the Raytheon Mfg. Co., Department 6260NR, Waltham 54, Mass. The unit, known as the Model G "Weldpower" head, is said to give extremely accurate and consistent electrode pressure through the use of a built-in, metallic-bellows air storage system. An air gage in the base of the welder head gives instantaneous indication of electrode pressure and permits rapid adjustment to a predetermined pressure. A small hand pump, available with the equipment, is all that is needed to supply the necessary air pressure.

The bench area required for mounting is 7 by 7 1/2 inches, and the unit is approximately 1 foot high. E-89

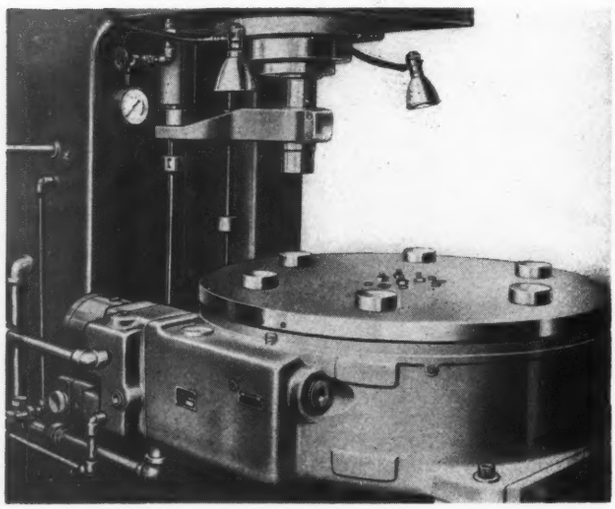
DoAll Cylindrical Grinding Attachment for Surface Grinders

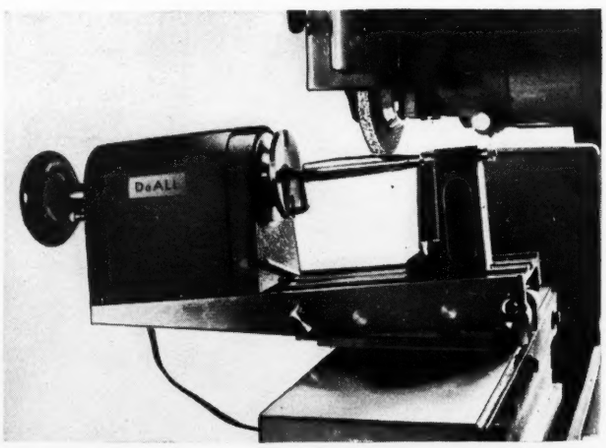
The DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill., announces a new cylindrical grinding and indexing attachment for use on surface grinders. Work is held either in collets or on centers, the capacity being 6 1/2 inches swing and 7 1/2 inches between centers. The spindle is driven by a built-in motor through step pulleys, giving speeds of 200, 400, and 700 R.P.M.

A two-way sine-bar tilting arrangement makes it possible to grind tapers up to 45 degrees, either forward or rear, permitting exact duplication of tapers without cut-and-try methods. The attachment is equipped with a twenty-four-division index-plate for the rapid and accurate grinding of square or angular punches and similar work. Index-plates having a greater number of divisions are also available.

The unit is quickly mounted on

(Below) Denison hydraulic index-table 33 inches in diameter with a 24-inch diameter work circle





(Above) Cylindrical grinding and indexing attachment for surface grinders, recently placed on the market by the DoAll Co. A built-in motor drives the wheel-spindle through step pulleys

To obtain additional information on equipment described here, use Inquiry Card on page 225.

a surface grinder or removed, being held in position by the magnetic chuck only. Long shafts up to 1/2 inch in diameter will pass through the spindle hole. Step collets and blanks are available for larger sizes—up to 3 inches. The spindle is mounted in Timken precision bearings. The equipment includes an adjustable indicator bar. E-90

Micromatic Hone for External Cylindrical Surfaces

The Micromatic Hone Corporation, 8100 Schoolcraft Ave., Detroit 4, Mich., has recently brought out a general-purpose tool known as the "Odee" hone for honing external surfaces. This tool will hone parts from 1/2 inch to 2 1/2 inches in diameter, regardless of length or material. It can be used with lathes, drill presses, or electric drills.

Close tolerances can be maintained on the work, and the diametral size is easily held to 0.0001 inch by means of a calibrated feed dial that gives absolute control of the in-feed of the abrasive. All out-of-roundness, waviness, and chatter marks left by previous machining operations are removed, as a geometrically accurate cylinder is generated. E-91

Hand torch utilizing a new fuel known as "Prepo"

New Fuel and Hand Torch

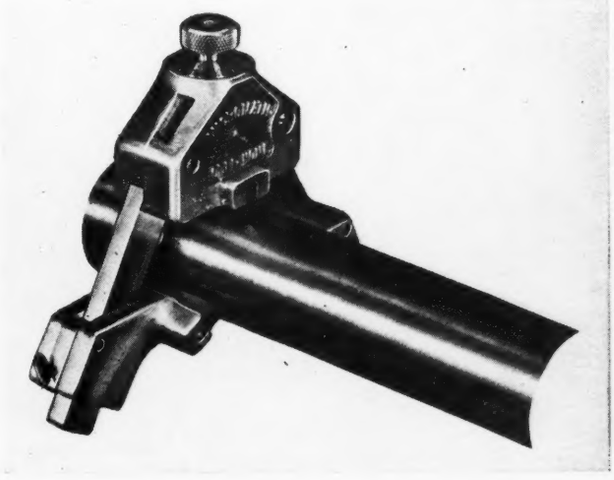
A self-pressurizing fuel for flame torches and other small heating appliances is being introduced by Pressure Products Corporation, 140 N. Dearborn St., Chicago 2, Ill. The fuel, called "Prepo," will be used with a new hand torch, and lights instantly, without either pouring or pumping, burning with a clean, blue flame of more than 2200 degrees F.

The fuel cannot be poured from the container, which is so designed that it cannot be opened. A rubber valve mounted on top of the container permits it to be attached to a mating fixture on the torch or other appliance. Thus the container serves as the fuel tank for the torch until empty, when it is quickly removed, thrown away, and replaced by a new one. The torch can be used in shops for such purposes as soft and silver soldering, bending, electrical repairs, lead burning, and other applications that require heat. E-92

Lepel Portable High-Frequency Heating Unit

A low-cost portable high-frequency induction heating unit has been introduced by Lepel High Frequency Laboratories, Inc., 39 W. 60th St., New York 23, N. Y., to meet the requirements of machine shops, tool-rooms, research laboratories, and educational institutions. It will heat a 1-inch length of steel rod to 1500 degrees F. in approximately 3 seconds, and will braze carbide tips to cutting tools up to 1 1/2 inches square.

The equipment can be used for hardening, annealing, normalizing, and soldering ferrous and non-ferrous metal. It operates on 110-volt, 60- or 50-cycle line current. Heating cycles can be pre-



"Odee" hone developed by Micromatic Hone Corporation

High-frequency heating unit brazing carbide tips to tools

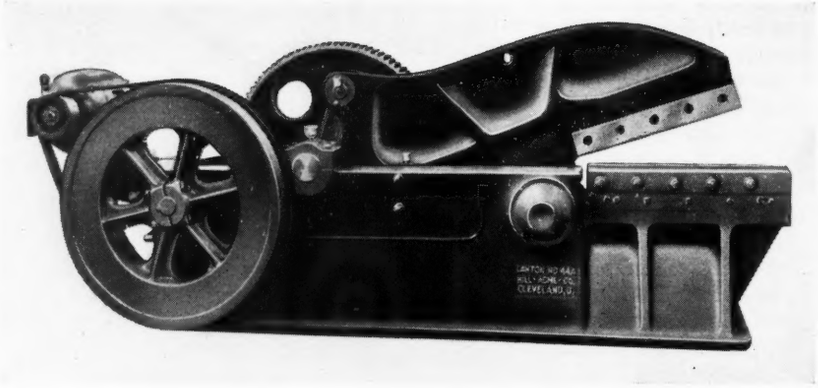
To obtain additional information on equipment described here, use Inquiry Card on page 225.

set for desired temperatures with an automatic timer. The unit is actuated by push-button or foot-operated switch. E-93

Canton Alligator Shear

The redesigned Canton alligator shear illustrated is being placed on the market by the Hill Acme Co., Canton Division, 1201 W. 65th St., Cleveland 2, Ohio, to replace the No. 3 size shear. The new shear, designated the Canton 44A, is of steel construction and has an adjustable knife seat that requires no shimming even after knives have been reground. It has bronze bushings throughout, and no foundation is needed.

This machine is made in high- and low-knife models and in either right- or left-hand styles. It has a capacity for shearing 4 1/4-inch rounds or 1- by 30-inch plates in mild steel. E-94



Redesigned Canton alligator shear placed on the market by the Hill Acme Co.

"Tapit" Hand Tapper for Machine Screw Threads

The "Tapit" hand tapper here illustrated is a new product of Photo Research Corporation, 127-129 W. Alameda Ave., Burbank, Calif. It is designed to speed tapping operations and eliminate tap breakage. In operation, the taps are held in positive alignment with the holes, and an adjustment is provided by means of which all holes can be tapped to a predetermined depth. The new tapper can be operated on a bench with the base permanently bolted in place or the upper half can be held in a vise or taken to the work. E-95

Snow Cross-Drilling Fixture

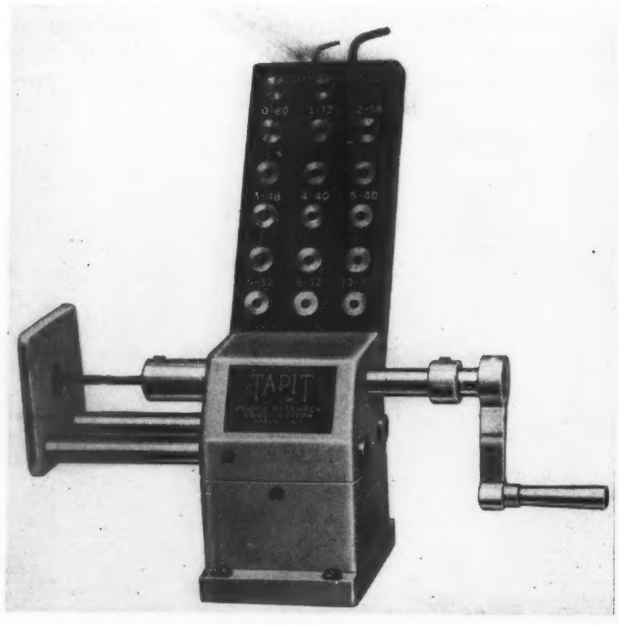
The Snow Mfg. Co., 435 Eastern Ave., Bellwood, Ill., has recently added a universal cross-drilling fixture to its line of automatic and semi-automatic master fixtures. The new No. 4 fixture is designed to permit a wide range of short- and long-run cross-drilling applications without the necessity of tooling for each job.

This fixture has four double-ended bushing plates with removable bushings covering drill sizes from No. 54 through 1/4 inch. A support stud on the fixture is adjustable in the vertical plane, and different sizes of notched vees in the top plate insure the proper clamping of parts having outside diameters from 7/32 through 1/2 inch. A separate V-block can be attached to support the end of long rods.

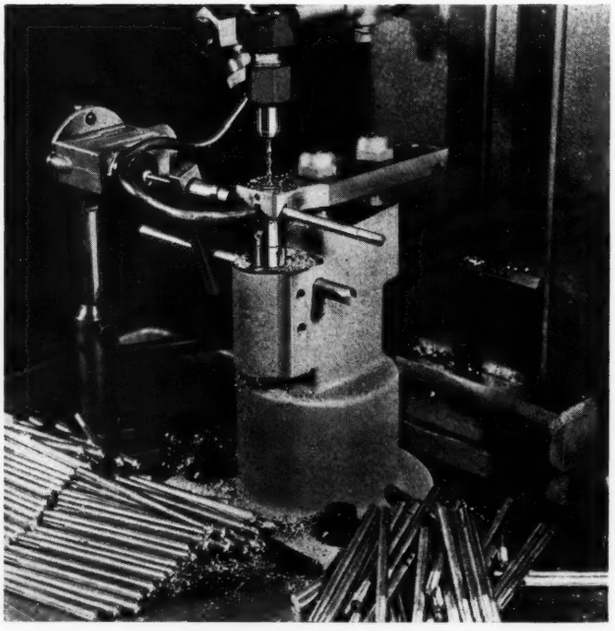
In addition, a spring "kick-out" is furnished to eject the part automatically after the drilling operation. E-96

Consolidated Straightening Machine for Light-Gage Sheet Metals

A new straightening machine is being introduced to the metalworking industry by the Consolidated Equipment Co., 2160 W. Wabansia Ave., Chicago 47, Ill. It is designed for straightening,

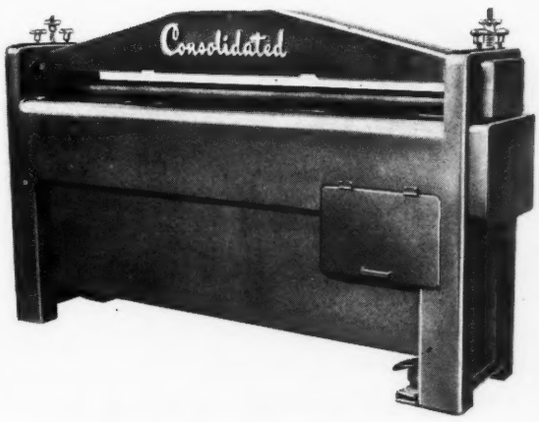


Hand tapper made by Photo Research Corporation

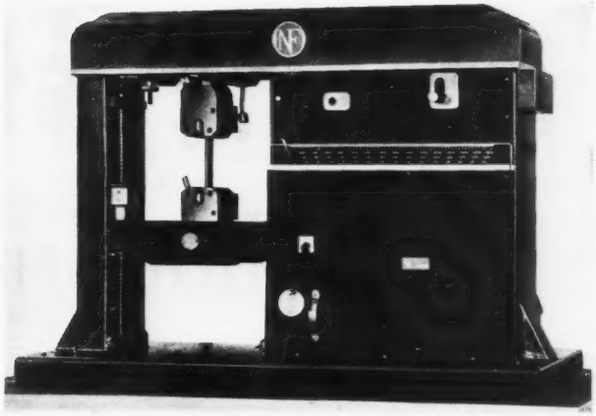


Snow universal cross-drilling fixture

To obtain additional information on equipment described here, use Inquiry Card on page 225.



Consolidated universal roller and straightening machine for sheet metals up to 18 gage



Universal testing machine for tension, compression, flexure, shear, and transverse tests

rolling, or form-rolling sheet stainless steel, aluminum, zinc, copper, cold-rolled and hot-rolled steel, and similar metals in thicknesses up to 18 gage. Three sizes are available, for sheets up to 36, 60, and 72 inches wide. E-97

Bristol Small Socket Screws

The Bristol Co., Mill Supply Division, 161 Bristol Road, Waterbury 20, Conn., announces the addition of smaller size socket set-screws and cap-screws to its line of multiple-spline socket-screw products. These are especially designed for use in small assemblies for equipment such as cameras, scientific instruments, electronic equipment, clocks, computing machines, etc. The new multiple-spline socket screws are made as small as No. 2 wire size, and the cap-screws are made in diameters to No. 0 wire size. ... E-98

Universal Testing Machine

A simplified, table model universal testing machine for tension, compression, flexure, shear, and transverse tests has been newly developed by the Testing Machine Division of the National Forge & Ordnance Co., Irvine, Warren County, Pa. It is available in two capacities—a 30,000-pound model with additional ranges of 6000 and 600 pounds; and a 15,000-pound model which can also be used for 3000- or 300-pound testing.

Loading of the machine is mechanical, the cross-head speeds being infinitely variable from 0.005 inch to 6 inches per minute. The weighing system consists of knife-edge pivot levers connected to calibrated steel elastic beams. The working space between columns is 20 inches with a 14-inch cross-head stroke. E-99

Starrett Universal Dial Bench Gage and Dial Depth Gage

The new No. 652 universal dial bench gage designed by the L. S. Starrett Co., Athol, Mass., is provided with a hand-lever which is pressed down to lift the spindle and released to bring the spindle into contact with the work. Left-hand operation permits easy handling of the work with the right hand; however, if desired, the lever can be furnished at the right. The dial can be adjusted relative to the zero graduation and then locked with the bezel clamp. Although other styles of indicators can be supplied, that regularly furnished has 0.0005-inch graduations and a range of 0.125 inch.

Universal dial bench gage manufactured by L. S. Starrett Co.

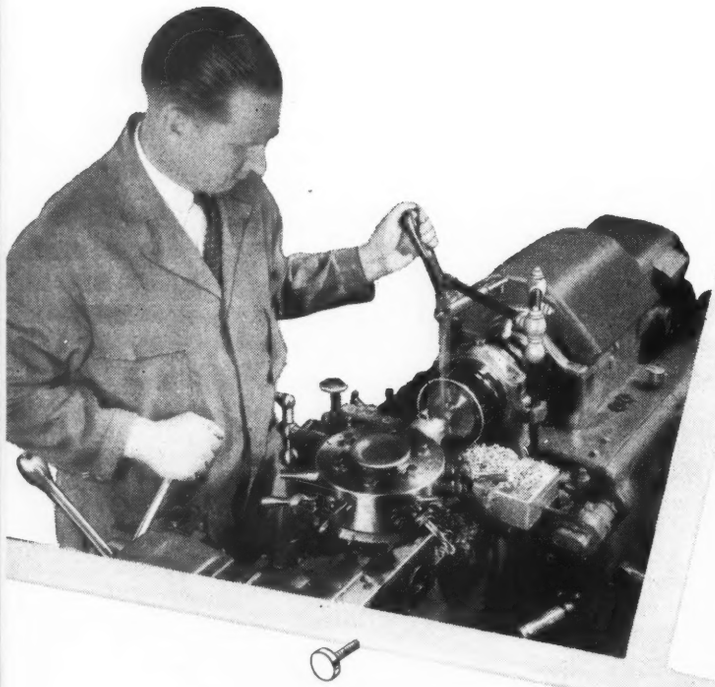
Starrett dial gage for measuring depth of small holes, slots, etc.

A new dial depth gage has also been brought out by the company. This No. 643 gage is especially useful for measuring the depth of holes, recesses, slots, etc., that are too small for an ordinary depth gage. It is operated by pressing down the push-button at the top, so that a needle-point rod contacts the work surface to be measured. Depths up to 0.125 inch are registered on the dial in 0.001-inch increments, or plus or minus variations can be measured directly. E-100

To obtain additional information on equipment described here, use Inquiry Card on page 225.

shop strategy

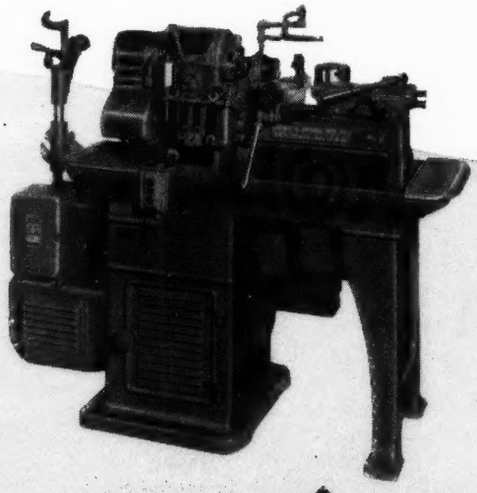
...that brings costs down



For short runs on bar stock or on second operations—

use Brown & Sharpe Wire Feed Screw Machines...

You'll get — • unusually fast, simple set-ups that reduce time of change-over and necessity of special tooling. • a choice of three machine sizes — each designed for top efficiency on work within its own range. • wide selection of spindle speeds (in two-speed combinations) permits efficient machining of materials from free-cutting brass to tough alloy steels. • advantages of simplified controls and semi-automatic movements that minimize operating fatigue.



No. 0 . . . Hole through largest regular feeding finger, 3/8". Turns any length to 2 1/4". Feed tube of 5/8" capacity for light to medium work can be furnished.

BROWN &

A SOUND INVESTMENT FOR AUTOMATIC SCREW AND SECOND OPERATIONS DEPARTMENTS

Wire feed screw machines can take over work that wouldn't be practical for efficient and economical handling on "automatics". Their time-saving, cost-saving advantages for short runs in turning, drilling, forming and threading parts, from the bar or second handling, pay off in better shop efficiency. What's more, they make possible bigger returns on your investment in automatics.

The wide range of spindle speeds on Brown & Sharpe Wire Feed Screw Machines permits you to select the most efficient speed for the job . . . whether the material is free-cutting brass or one of the tough-alloy steels. In addition, in most cases, you can use the same tools and the same collets and fingers as on your Brown & Sharpe automatics.

Specific Features of Brown & Sharpe Wire Feed Screw Machines

Simple to operate . . . for example, a single lever controls the spindle — for high speed, low speed and stop. Stop position is particularly valuable for second operations. Automatic chuck and bar feed is tripped quickly by hand or automatically.

Minimum number of controls . . . waste motion eliminated. Operator fatigue reduced. Efficiency raised.

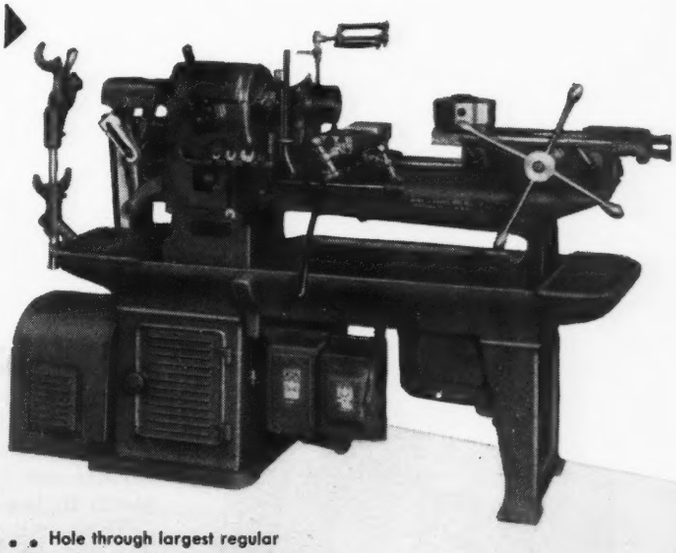
Stock fed in ¾ second . . . rapid power feed of stock and the automatic chuck save time — reduce cost per piece.

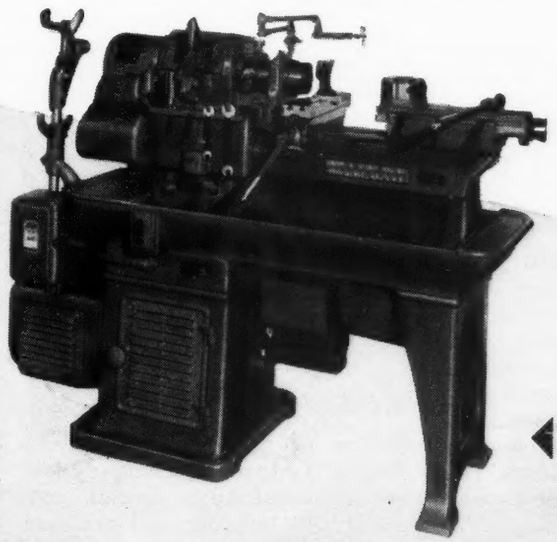
Twenty spindle speeds . . . 20 changes of spindle speed (ten high-low combinations)—all in same direction or in opposite directions. Approximate ratios, fast to slow, are 5 to 1.

Ample spindle capacity . . . feed tube regularly furnished with each machine accommodates all bar stock up to rated capacity of machine. Oversize feed tube is available for work of larger diameter than the rated machine capacity, or work can be held or chucked in extra capacity collets.

Here's the type of shop strategy that's timely and profitable. Write for complete details. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

No. 2 . . . Hole through largest regular capacity feeding finger, 1″. Turns any length to 6″. Feed tube of 1¼″ capacity for light to medium work can be furnished.





No. 1 . . . Hole through largest regular feeding finger, ⅝″. Turns any length to 4″. Feed tube of ⅜″ capacity for light to medium work can be furnished.

SHARPE B·S

Delta universal vise with four separate planes of adjustment

Delta Universal Vise

A universal vise known as the "Univise" has recently been developed by the Delta Power Tool Division, Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1, Wis. This vise fits any surface grinder or tool grinder, and can also be used on a drill press or other machine without table slots or on a magnetic chuck.

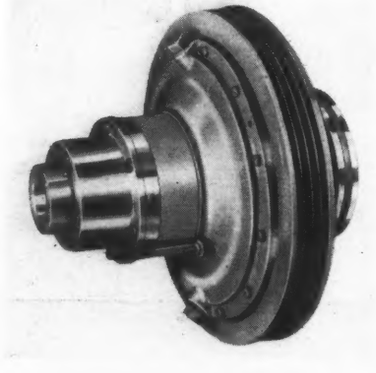
The "Univise" is made up of four separate parts, each of which can be rotated, providing four separate planes of adjustment, so that a tool can be held at any conceivable angle. Each part has a circular scale of 360 degrees. Settings can be made directly from a blueprint, and for duplicate grinding, the vise can be returned exactly to its original setting.

The vise is 5 13/16 inches high, 6 inches wide, and 7 1/4 inches long. E-101

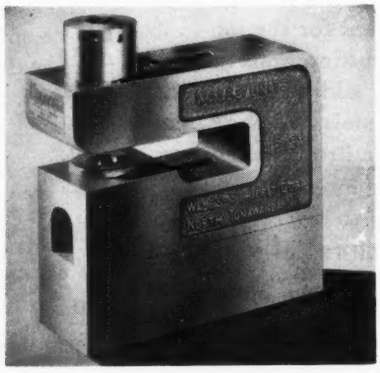
Vickers Magnetic-Particle Clutch

A new line of Magneclutches for controlling torque, speed, and position has been introduced by the Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis Mo. The Magneclutch is a controllable coupling which utilizes the linking action of a dry magnetic mixture in a magnetic field between the driving and driven parts to transmit torque. The magnetic mixture is composed of iron particles and flake graphite. The magnetic field is established by current flowing through a coil, and the degree of clutching can be controlled by varying the current.

Operating advantages include no wear on torque transmitting surfaces; torque at zero slippage; large maximum-to-minimum torque ratio; and easy adaptation to remote control. E-102



Vickers magnetic-particle clutch



Hole punching unit with split punches

Wales Hole Punching Units

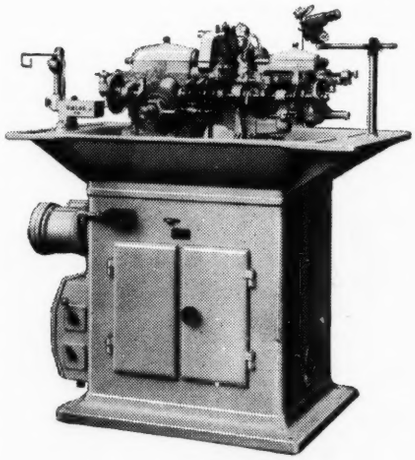
Hole punching units for punching holes in 1/2-inch thick mild steel have been added to the line of the Wales-Strippit Corporation, 345 Payne Ave., North Tonawanda, N. Y. The new Type G units are equipped with split punches, which eliminates the high pressures and over-size springs usually required for stripping the tools out of punched holes. The three-piece split punch collapses sufficiently to free itself from the wall after punching the hole. In this way, only small lifter springs are required to raise the punch to the required position.

The split-punch assemblies, dies, guides, and lifter springs are designed into the holders. The holders automatically keep the split-punch assemblies and dies aligned for the life of the units. Nothing is attached to the press ram, the only function of the ram being to force the split-punch assembly through the work. E-103

Omlor High-Precision Single-Spindle Automatic Screw Machine

The Model M Omlor single-spindle automatic screw machine introduced by the American Trading Co., Inc., 96 Wall St., New York 5, N. Y., has been developed for high-precision long turning, fine screw cutting and formed-part jobs. It is designed to use four tools only in order to obtain greater rigidity. As the slotting attachment can be used without removing any of the tool-holders, and the lateral centering devices are combined with drilling and threading attachments, operations otherwise performed on machines with five tools can be accomplished on this machine.

Three of the tool-holders are equipped with positive, micrometrically set stops, preventing any inaccuracy in cams, levers, or tool-holders from being transmitted to the work-piece. Three diameters can be machined without cams by means of these tool-holders. The three stop-equipped tool-holders can also be operated through corresponding cams. The machine is equipped with flat, non-slotted cams, eliminating complicated and expensive bell cams.



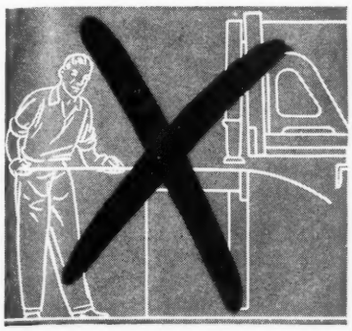
Omlor single-spindle automatic screw machine introduced by the American Trading Co.

The collet chuck, holding the bar, is tightened by clamping levers, actuated by a special, patented ball balancer and pressure cone. This device reduces clamping time and increases the output. This machine is said to produce work to a tolerance of ± 0.00008 inch. E-104

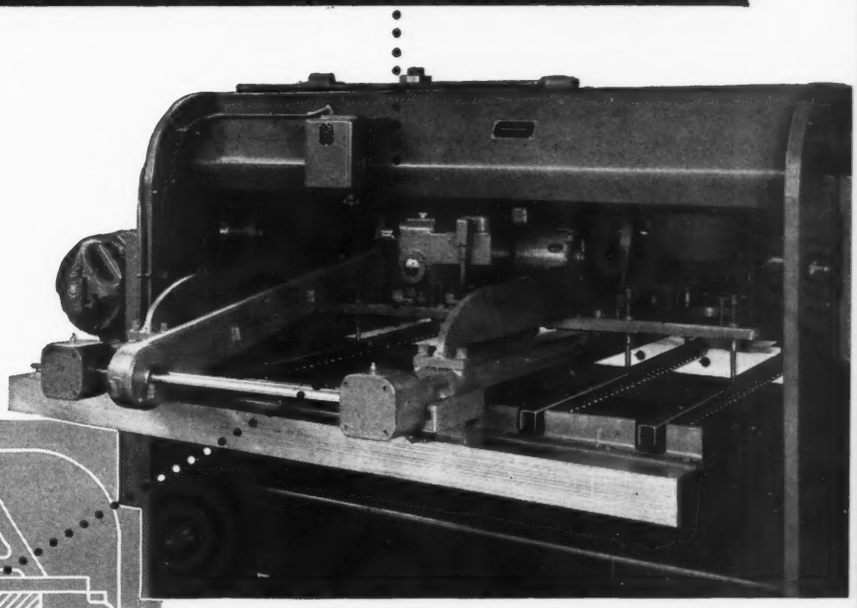
To obtain additional information on equipment described here, use Inquiry Card on page 225.

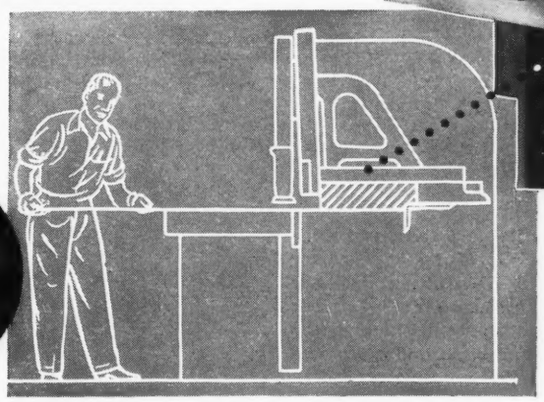
Another Cincinnati Feature

. . . the No-Sag Magnetic Sheet Support



Troublesome Sag



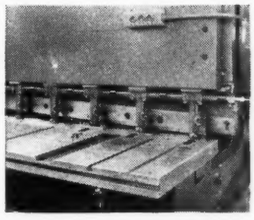


Quick gauging—easy handling

WRITE for detailed information

Thin steel sheets that sag, and normally are difficult to back gauge, are handled easily and accurately with the Cincinnati Magnetic Sheet Support. Costs are reduced, production increased, and quality of product improved. Maximum capacity: 16 gauge. Range: 36″ to 48″; for magnetic sheets only. Available as extra equipment on new Cincinnati Shears.

Other features pioneered by Cincinnati FOR SPEEDY AND ACCURATE, PROFITABLE SHEARING

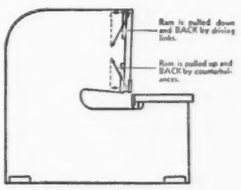


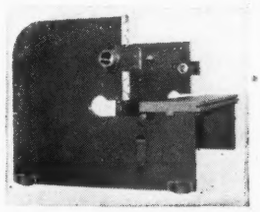
HYDRAULIC HOLDDOWNS

Tons of pressure hold the work securely—a necessity for accurate cutting.

NON-FLOAT INCLINED RAM

Produces the most accurate shearing in the field and gives six major advantages — including shearing different thicknesses without changing knife clearance.



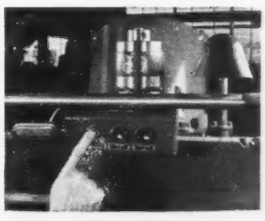


ALL-STEEL, NON-BREAKABLE FRAME

Developed and pioneered by The Cincinnati Shaper Company for long life and accurate performance.

PRECISION BACK GAUGE

Accurate to .002″—easy to use. Power front or standard hand control.

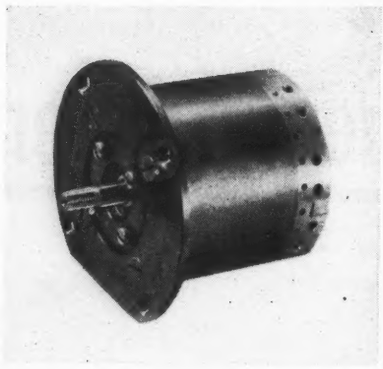


THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

CINCINNATI

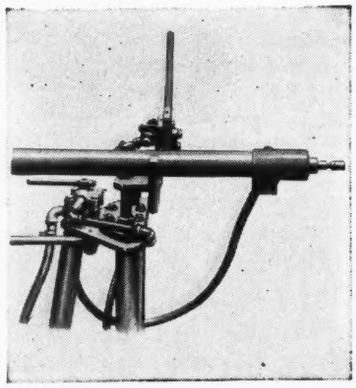


Barber-Colman Magnetic Clutch for Rapid Engagement and Release

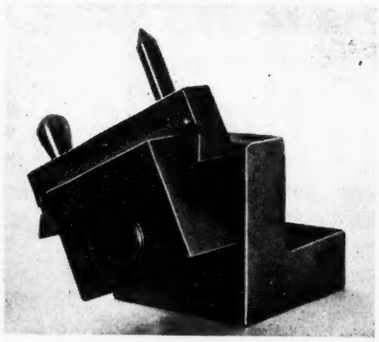
Magnetic clutch designed for use with "servos" and other devices where rapid engagement and release are required. Has a capacity of 0.20 H.P. with an input of 3 watts. When the electromagnet is energized, the cork-faced driven disk is clamped between two driving members. For high torque transmission, the driven disk is faced on both sides. A splined bore in the driven disk permits easy coupling to the load. Slip rings and auxiliary bearings are eliminated by the use of a nonrotating electromagnet with a flange mounting. The driving plates are ventilated for rapid cooling. Maximum torque is 4 pound-inches, and maximum speed 3600 R.P.M. The electromagnet input is 3 watts direct current or rectified alternating current. Developed by Barber-Colman Co., 6226 Loomis St., Rockford, Ill. E-105

Automatic Air-Operated Bar Feed

Completely automatic air-operated bar feed for hand and automatic screw machines and turret lathes, marketed by the OK Specialty Co., Inc., 910 W. Lake St., Chicago 7, Ill. This bar feed will handle 12-foot stock bars of all shapes and sizes, and will feed any required length to the stop. It is limited only by the inside diameter of the machine tool spindle. Permits use of exact size polished stock, thus saving additional operations. The bar-feed

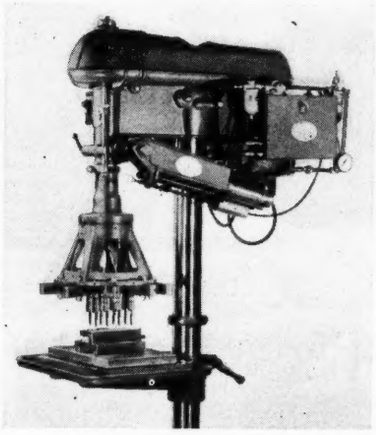


tube is adjustably mounted on two tripod standards. Operating on very low air pressure, a 1/4-H.P. compressor will handle many such units. This bar feed is especially useful for feeding polished steel and brass and aluminum rod; thin-wall tubing; plastic parts; round, square, hexagonal, and rectangular shapes, etc. E-106



Grinding-Wheel Angle-Dresser

"Mighty Midget" angle-dresser announced by Sperman Metal Specialties, 2199 E. 21st St., Brooklyn 29, N. Y. In dressing a grinding wheel, the angle can be set with a protractor from any of the ground sides or base, or it can be set with a sine bar for more precise work. This tool works underneath the wheel so that it is unnecessary to remove wheel guard for dressing.....E-108

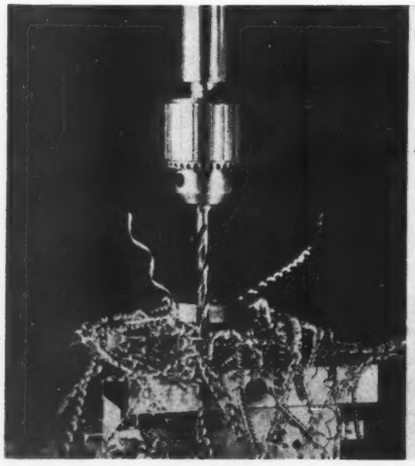


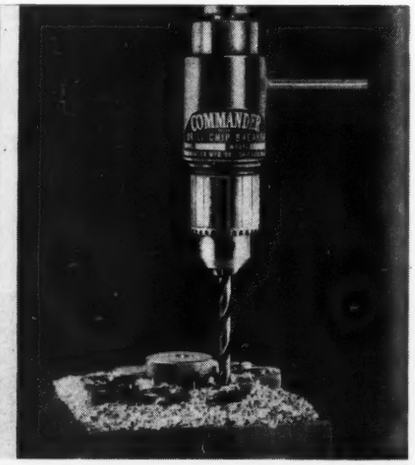
Beckett-Harcum Air-Powered Drill-Press Feed

Automatic air power feed for small drill presses, developed by the Beckett-Harcum Co., Wayne Road, Wilmington, Ohio. These feeds operate on low pressures, and will provide the proper thrust and correct drilling action for practically any size drill working in any material. Available in either standard or heavy-duty models in four feed types: (1) Drill; (2) drill with dwell; (3) drill, chip clean, and dwell; (4) drill and tap. Models are designed to fit all drill presses having 1 1/4-inch diameter pinion-shafts, and are readily adapted to shafts of other sizes. On standard models, the maximum length of stroke is 2 1/2 inches. The standard feed develops from 4 to 750 pounds drill-point thrust. Heavy-duty feeds have a maximum length of stroke of 4 inches, and develop from 10 to 1250 pounds drill-point thrust. E-109

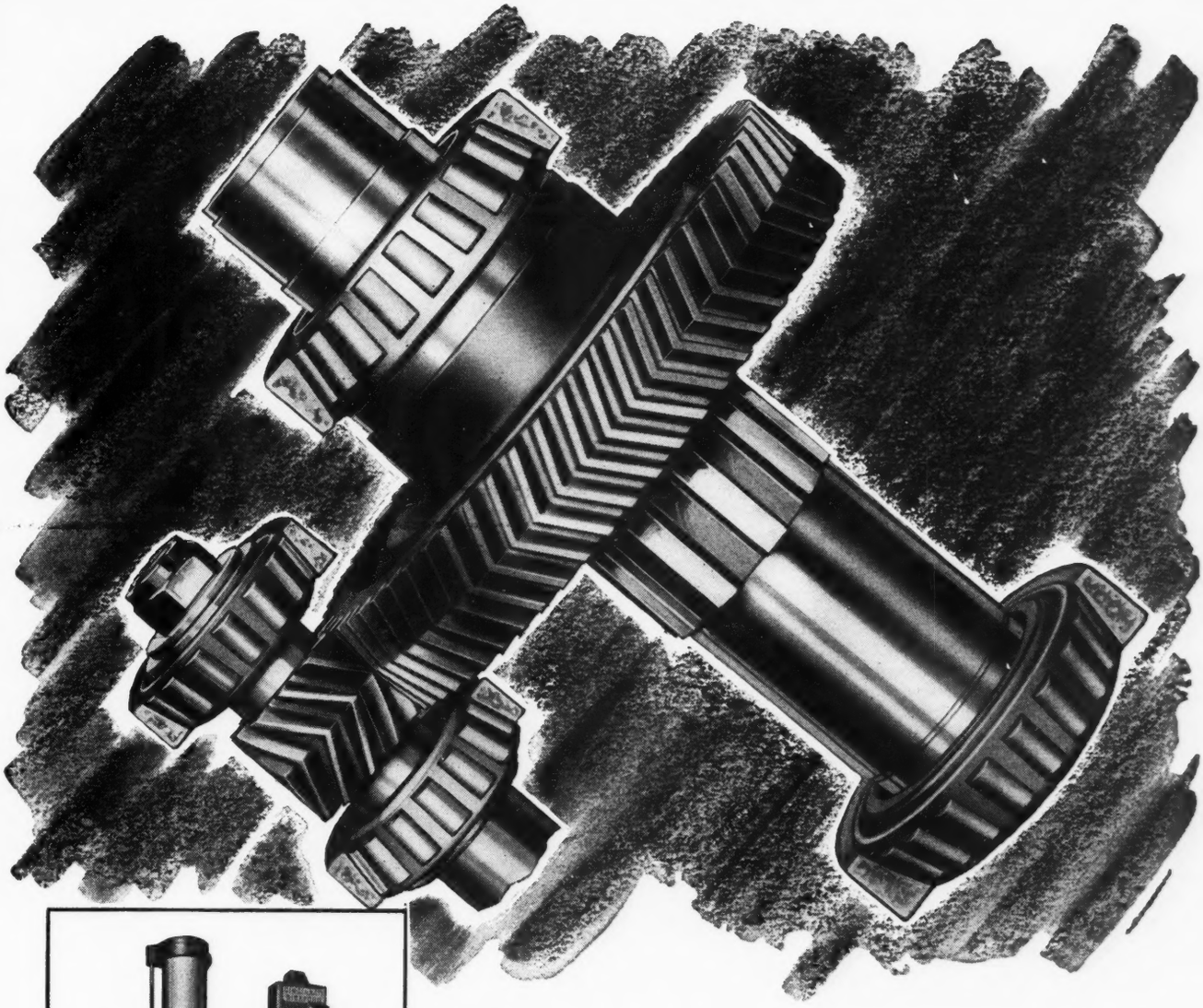
Commander Drill Chip-Breaker

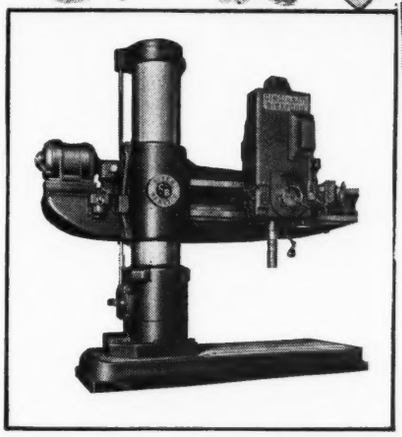
View at right shows chips produced when using a new drill chip-breaker made by the Commander Mfg. Co., 4225 W. Kinzie St., Chicago 24, Ill. View at left shows chips produced when same piece was drilled without the chip-breaker. The new chip-breaker produces short chips which give a free cutting action and allow coolant to flow down the flutes to reach the drill point. Especially advantageous in deep-hole drilling. The safety of the operator and the speed with which the work can be handled are increased due to the elimination of whirling, sharp spiral chips. E-107





To obtain additional information on equipment described here, use Inquiry Card on page 225.





On EVERY JOB you do—

The smooth, chatterless, powerful and durable drive of the Cincinnati Bickford Super Service Radial Drill is a success factor in every job you do.

Driven by 10 splines machined from the solid, the driving gear is mounted on a special continuous bronze alloy sleeve which is carried by anti-friction bearings mounted on close centers.

Herringbone, continuous tooth gears are used for the lower speed ranges—for strength and smooth-rolling action.

The large continuous tooth gear never exceeds 500′ peripheral speed a minute, automatically declutches at high speeds and eliminates strains of flywheel inertia on high speeds and on spindle reverse.

Such design and engineering give Cincinnati Bickford Super Service Radial Drills great accuracy and a long life of trouble-free operation.

Write for the detailed bulletin No. R-29 for complete data.

THE CINCINNATI BICKFORD TOOL CO.

RADIAL AND UPRIGHT SUPER SERVICE DRILLING MACHINES

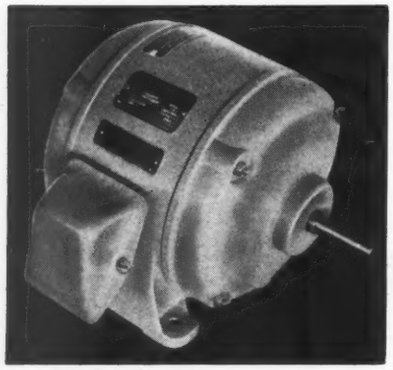
Radials 7½" dia. col., 2½' arm, to 26" dia. col., 12' arm.
General purpose Uprights, 21" to 28" sizes.
Production Uprights 21" to 28".
Jig Borers, Portable Horizontals, Spacing Table Machines.

Equal Efficiency of Every Unit Makes the Balanced Machine

THE CINCINNATI BICKFORD TOOL CO. Cincinnati 9, Ohio U.S.A.

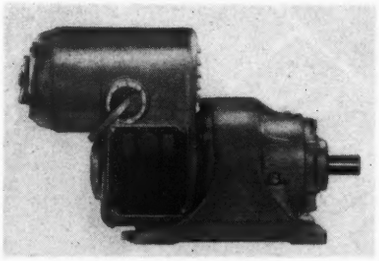
Alternating-Current Dynamic Brake Motor

Alternating-current motor designed for applications requiring quick stopping. Fundamentally, this is an induction motor with a standard squirrel-cage rotor. The stator, however, employs a single-phase alternating-current winding for electrodynamic braking, in addition to its running winding. Under influence of the braking winding, a retarding force several times that of full-load torque is applied to the rotor. As the motor approaches a complete stop, the braking force becomes negligible, thereby permitting shifting of gears, turning by hand, and position-stopping. Developed by Standard Dayton Corporation, Box 1001, Dayton 1, Ohio. E-110



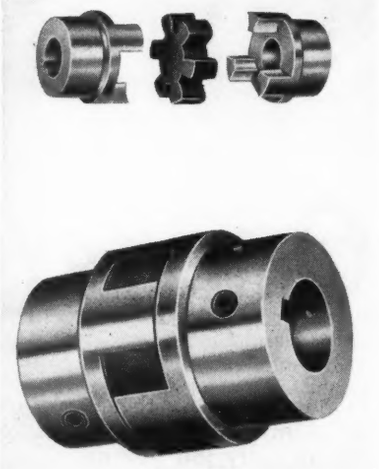
"Cro-Hone" Wet Blaster

"Cro-Hone" wet blaster employing fine abrasive suspended in a liquid which is forced against the work by air pressure. Developed by the Cro-Plate Co., Inc., 3343-47 Main St., Hartford 5, Conn., for initial die and mold polishing, surface preparation and cleaning prior to electroplating, formation of surfaces with high oil-retention properties, and many other applications in the metal-working industry. E-111



Combination Geared Variable-Speed Motor

Fractional-horsepower motor designed for use where a light-weight industrial motor is needed. It combines in one unit a "Varidrive," which permits instant change of speed in a ratio of 1 to 10, and a heavy-duty "Syncrogear" for increasing the torque. This Type VA-GD motor is available in sizes of 1/4, 1/3, 1/2, and 3/4 H.P. Speed ranges are from 10 to 10,000 R.P.M. The frame of the "Varidrive" is of cast aluminum. A new type of dial control permits instant speed change by turning the handle less than one revolution. Developed by U. S. Electrical Motors, Inc., 200 E. Slauson Ave., Los Angeles 54, Calif. E-112

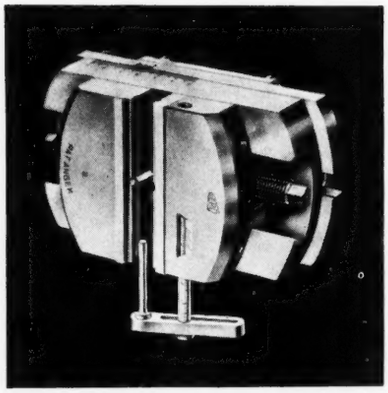


Flexible Coupling of New Design

The specially designed concave jaw surface of the flexible coupling illustrated, which was developed by Gerbing Mfg. Corporation, Roto Cone Variable Speed Pulley Division, Northbrook, Ill., holds a resilient synthetic rubber insert or spider in position. Any tendency of the rubber to extrude or break is eliminated. The coupling is available for use on shafts from 1/2 to 1 5/8 inches in diameter and for horsepower ranges from fractional to 25. The coupling instantly adjusts itself for misalignment, and provides a vibration-free drive for a wide range of applications. E-113

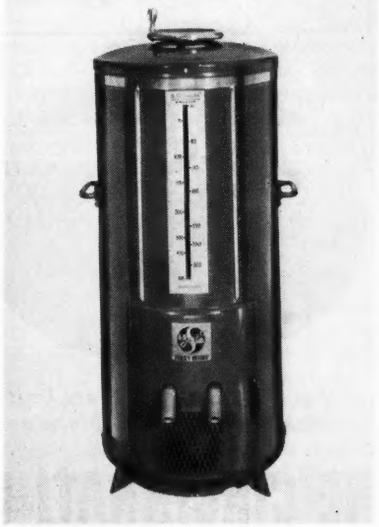
"Zus" Universal Chuck

"Zus" universal chuck that permits fast, accurate clamping of work which cannot be held in collets, three-jaw chucks, or other standard clamping devices. It is intended for use on lathes, indexing heads, circular tables of milling machines, and similar machine tools. This chuck clamps work concentrically, and can be adjusted eccentrically. Sold in the United States and Canada by the Cosa Corporation, 405 Lexington Ave., New York 17. ....E-114

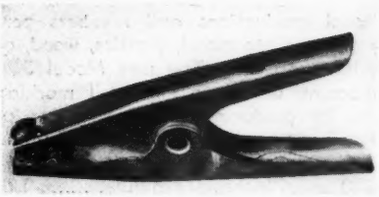


Smith Welding Transformer

New 400-ampere welding transformer (Model 400E) made by A. O. Smith Corporation, P. O. Box 584, Milwaukee 1, Wis. It has a welding range of 70 to 585 amperes, and is rated in accordance with N.E.M.A. specifications—400 amperes at 60 per cent duty cycle. Fan motor and capacitors of the new transformer are easily accessible for maintenance through the hinged door at the front of the machine. An industrial type heavy-duty motor and fan blade provide high-velocity air for cleaning and cooling the coils. E-115

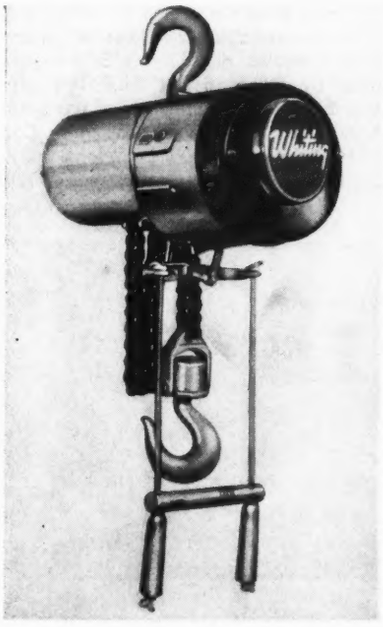


To obtain additional information on equipment described here, use Inquiry Card on page 225.



Lincoln Ground Clamp for Welding Jobs

Light-weight ground clamp of 300 amperes capacity for welding jobs, developed by the Lincoln Electric Co. of Cleveland 1, Ohio. The clamp weighs only 1 1/2 pounds and has a jaw spread of 2 1/2 inches. A heavy, direct-acting spring gives a positive, slip-proof connection with the work, so that the clamp provides a readily movable, yet solid ground connection for welding jobs where currents do not average over 300 amperes. The frame is made of pressed-steel construction. The jaws are made of a special steel and copper alloy known as "Lincalloy," which is highly conductive and has great wear resistance. E-116

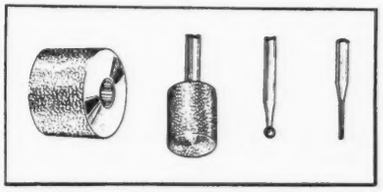


Whiting Electric Chain Hoists

One of an improved line of electric roller-chain hoists just announced by the Whiting Corporation, Harvey, Ill. The pull-cord has been located at the center instead of at the end of the hoist frame to eliminate any tendency of the hoist to tip when the control cord is pulled. The hoist control switch also is relocated and simplified, and is protected from damage by a new switch mounting. These hoists are available in 1/4-, 1/2-, 1-, and 2-ton capacities. E-117

Diamond Wheels with New Metal Bond

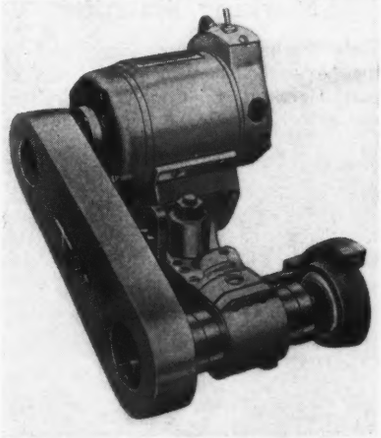
Diamond wheels that employ diamond powder in extremely high concentrations with a new metal bond of extreme toughness. These wheels are applicable for grinding steel, carbides,

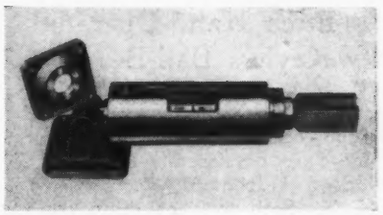


glass, and ceramics, as well as all hard alloys. They retain their shape well, cut rapidly, and have exceptional life. They are made in sizes of 3/64 inch diameter and larger. Can be used in portable grinders, lathes, milling machines, drill presses, jig grinders, die-sinking machines, etc., for grinding dies of all types, internal grinding, sharpening small acorn dies, enlarging keyways, and grinding dovetails. These wheels are furnished either mounted or unmounted and many special shapes can be made to order. Made by Starlite Industries, 58th at Market St., Philadelphia 39, Pa. E-118

"Knock-Out" Toolpost and Thread Grinder

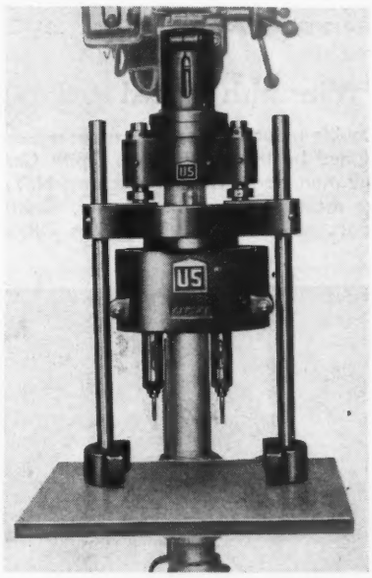
Thread grinding, in addition to internal, external, and surface grinding, can be done with the new "Knock-out" toolpost and thread grinder illustrated, which has been introduced by the K. O. Lee Co., Aberdeen, S. D. The T500 grinder utilizes a T-slot mounting, and can be easily applied to most standard machine tools. It enables grinding operations to be performed to tolerances as close as 0.0001 inch. A 5/8-H.P., universal type alternating-direct-current motor is supplied for operation on 115 or 230 volts. Spindle speeds range from 5000 to 32,000 R.P.M. E-119





Modernair Double-Acting Air Cylinder

Improved double-acting air cylinder introduced by Modernair Corporation, 4222 Hollis St., Oakland 8, Calif. This "Air Return" cylinder may be operated by a three-way valve and still allow throttling to provide for control of work and of the return stroke. After the initial charge of air, the cylinder operates on the same number of cubic feet of air as a spring return cylinder. These air cylinders are available in 1 1/8-inch, 1 3/4-inch, and 2 1/2-inch bore sizes, and can be obtained with keyed piston-rods to eliminate rotation for light punch and die work. E-120



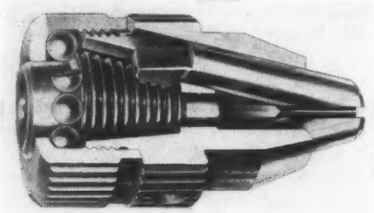
Drill Head and Tapping Unit

Adjustable head mounted on a tapping unit for use on a machine that does not have a reversing spindle. Available in fifty-six sizes and five types, covering a capacity range of from 1/4 inch to 1 1/2 inches. When furnished for tapping, the spindles can be equipped with single-purpose tap chucks, floating tap-holders, or safety tap-holders. Use of the safety tap-holders permits the hole to be tapped to the bottom without tap breakage. By locking the tapping unit, the complete set-up can be used for drilling. Announced by the United States Drill Head Co., (Department X), 616 Burns St., Cincinnati 4, Ohio. E-121

To obtain additional information on equipment described here, use Inquiry Card on page 225.

Ettco Hand-Operated Keyless Ball-Bearing Drill Chuck

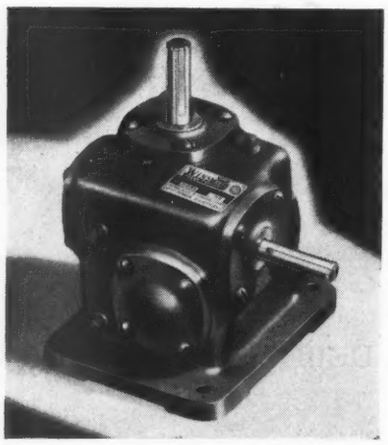
Hand - operated keyless ball - bearing drill chuck developed by Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 6, N. Y. Such tools as drills, reamers, counterbores, end-mills, or any type shank tool can merely be inserted in the chuck and tightened by hand, since machining action centers the tool and tightens the grip, thereby preventing



slippage. These Ettco-Emrick chucks can be used on any type of drill press, electric drill, lathe, milling machine, etc., or for any application where positive gripping power is required. ..E-122

"Winsmith" Speed Reducer

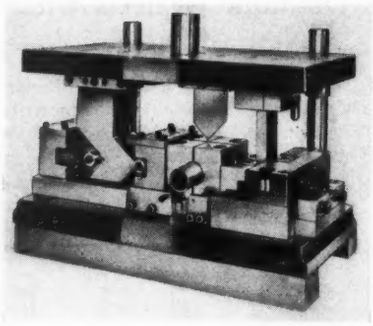
Double-reduction speed reducer designed by the Winfield H. Smith Corporation, Springville, Erie County, N. Y., to meet fractional-horsepower, small-space requirements. This Type DBRA



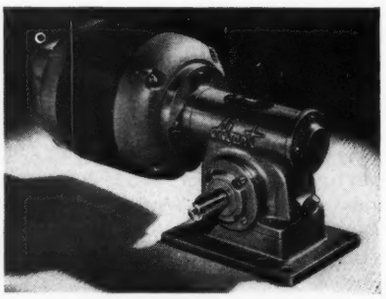
addition to the "Winsmith" line is designed for a multitude of duties in the transmission of small power loads, and is stocked in twenty-four different right-angle drive assemblies. It is available in sizes of 1/20 to 1/8 H.P. and in reduction ratios of 25 to 1 to 1764 to 1. .....E-123

Vogel Tube Cut-Off Shear

High-speed tube cut-off shear with horizontal and vertical blades, which is capable of cutting off up to 6000



pieces per hour while maintaining an accuracy of 0.004 inch on the length of the part. Tubing of any size, shape, or wall thickness up to 3 inches outside diameter can be cut off. Interchangeable dies permit quick change over from one diameter to another. Developed by the Vogel Tool & Die Corporation, 2527 W. Moffat St., Chicago, Ill. E-124

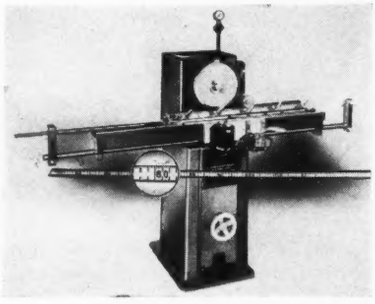


Abart Right-Angle Gearmotors

One of a new line of right-angle type single-phase and three-phase gearmotors manufactured by Abart Gear & Machine Co., 4828-36 W. 16th St., Chicago 50, Ill. Specifications are as follows: Horsepower, 1/6 to 5; ratios, 5 4/5:1 to 100:1; output speeds, from 17.5 R.P.M. to 302 R.P.M. Special voltages, cycles, etc., are furnished on order. E-125

Noble & Westbrook Power-Operated Scale Marking Machine

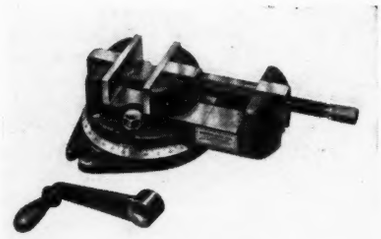
Scale marking machine developed by the Noble & Westbrook Mfg. Co. of East Hartford 8, Conn., for rolling



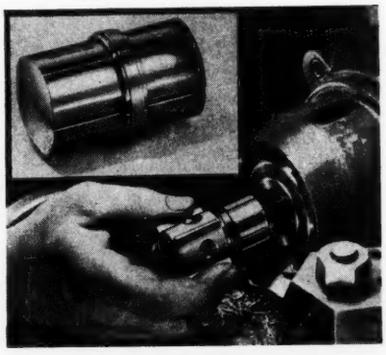
lineal graduations and numbers permanently into metal, plastics, wood, or other materials. The new Model 306 machine utilizes a steel roll marking die for producing the sunken inscription in the work-piece. Lengths up to 3 feet can be marked at speeds up to 300 lineal inches per minute. E-126

Kenco Swivel-Base Vise

Swivel-base vise with unique system of numerical graduations around the beveled edge of the base, reading from



0 to 90 degrees and then back to 0, thus allowing synchronized readings from markers on either side of vise. The new 4-inch vise has hardened and ground removable steel jaws which are 1 1/4 inches deep by 3 5/8 inches wide by 5/16 inch thick. The vise may be used independently of the base. Announced by the Kenco Mfg. Co., 5211 Telegraph Road, Los Angeles 22, Calif. E-127

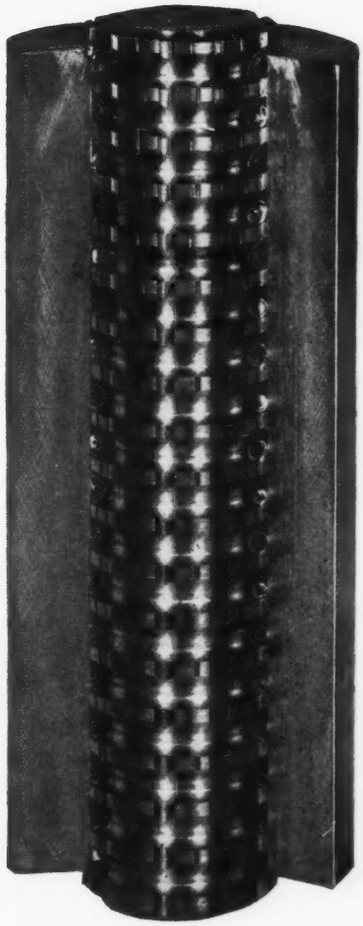


"Auto-Arb" Expanding Arbors

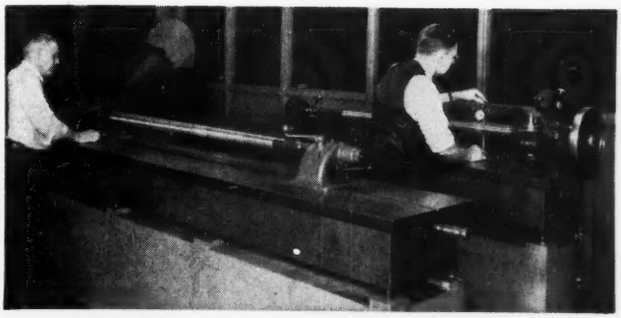
"Auto-Arb" expanding arbor recently brought out by the Asco Corporation, 17718 Waterloo Road, Cleveland 19, Ohio, in a new range of sizes. The new Type B series will accommodate work with inside diameters from 33/64 inch to 1 inch on a machine with a 1/2 inch collet, and from 1 1/64 to 1 1/2 inches with a 1-inch collet. These tools are designed to hold work-pieces by the inside diameter while machining, counterboring, chamfering, or finishing the outside surface. Work can be chucked or unchucked without stopping the spindle. E-128

To obtain additional information on equipment described here, use Inquiry Card on page 225.

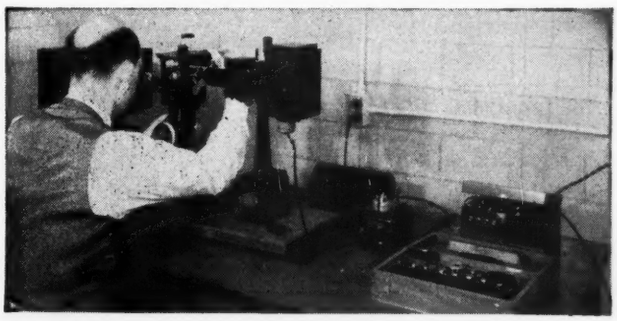
What makes a broach GOOD?



Typical of Colonial's continuous research on chip characteristics and the effect of various factors such as material, pitch, breaker spacing, etc., is this study on "deep hole" spline broaching.

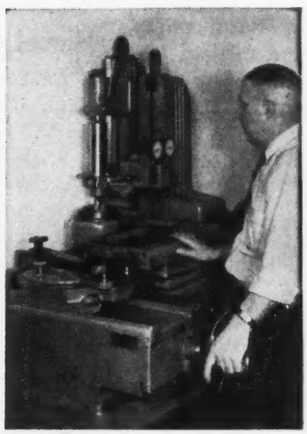


At right, index and spacing checker for spline or serration broaches. Also checks lead. In front, special surface plate to check alignment. Note comparator in background for checking complex contours on broached samples.



Metallographic analysis of heat-treated specimens (taken at different radii on large broaches), precedes fabrication.

A complete chemical and physical lab provides facilities for metal analysis. Operated by trained technicians.



Test pieces produced during the grinding of involute splines on broaches are checked on this Michigan Tool involute checker.

A **GOOD** broach is about the most inexpensive tool you can buy—based on the number of finished pieces which it will produce. On the same basis, a poor or mediocre broach can be a costly investment, no matter what you pay for it.

Colonial's ability to consistently design and produce **GOOD** broaches is no accident. It is a matter of constant vigilance—checking and re-checking at every stage—plus the finest of inspection "tools". Here are some of the facilities that make Colonial broaches **GOOD** broaches.

For the name of Colonial's representative in your area, write (Box 37, Harper Sta.), wire, or phone (LA. 7-1600) today.

PIONEERS OF H.S.S. BROACHING

COLONIAL

BROACH CO. DETROIT 13

Colonial Makes **GOOD** *Broaches*

New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To obtain copies of these publications, fill in identifying number at end of descriptive paragraph on Inquiry Card, page 225, or write directly to manufacturer, mentioning catalogue described in the August, 1950, number of MACHINERY.

Care of Drills and Reamers

CHICAGO-LATROBE TWIST DRILL WORKS, 411 W. Ontario St., Chicago 10, Ill. Booklet entitled "Care of Drills and Reamers," containing recommendations for tool supervisors, master mechanics, tool-room foremen, and other users of drills and reamers on how to increase the life of these cutting tools through proper care. The recommendations cover tungsten-carbide tools as well as high-speed steel tools. Copies are available to those who request them on business stationery addressed to the company.

Stock List of Steels

UNITED STATES STEEL SUPPLY Co., 71 Broadway, New York 6, N. Y. Stock list and reference book (1950-51) containing a complete list of the company's stocks of carbon steel, stainless steel, alloy steel, and tubing, as well as approximately 75 pages devoted to a variety of machinery and industrial supplies. Technical tables of weights, loads, conversions, etc., are included, and the book is indexed for easy reference.....C-1

Standard Tap Catalogue Numbers

THREADWELL TAP & DIE Co., Greenfield, Mass. Folder containing a standard tap catalogue numbers conversion table, containing a complete list of standard taps, in all styles and types, together with catalogue numbers of all American tap manufacturers. Designed either for filing or binding in catalogues. C-2

Interchangeable Punches

WHITMAN & BARNES, DIVISION UNITED DRILL & TOOL CORPORATION, Plymouth, Mich. Catalogue 103, illustrating and describing the Whitman & Barnes expanded system of Hercules interchangeable punches and applications of this system for various piercing requirements in a number of stamping plants. C-3

Precision-Ground Flat Stock and Die Stock

L. S. STARRETT Co., Athol, Mass. Bulletin 1103, listing all available sizes of Starrett precision-ground flat stock and die stock, made in oil-hardening, oil- and water-hardening and water-hardening types. Information on analysis, heat-treatment, and tempering, as well as prices, are included.....C-4

Sheet-Metal Contract Work

GEUDER, PAESCHKE & FREY Co., Milwaukee 1, Wis. Catalogue entitled "Science and Skill in Sheet Metals," illustrating and describing the facilities offered by the Contract Division of the company for producing sheet-metal parts or sub-assemblies and typical examples of parts made by the company. C-5

Analysis and Sorting of Metal Parts

J. W. DICE Co., 1 Engle St., Englewood, N. J. Bulletin 2005, descriptive of new high-speed automatic "Cyclograph" equipment for non-destructive sorting and inspection of metal parts according to their metallurgical characteristics. C-6

Self-Tapping Screws

PARKER - KALON CORPORATION, 202 Varick St., New York 14, N. Y. 48-page bulletin (Form 430) containing complete data on the various types of self-tapping screws made by the company, including application information, hole sizes, stock sizes, head styles, and valuable engineering data. C-7

Grinding and Finishing Laboratory

BEHR-MANNING, Troy, N. Y. Bulletin entitled "Proving Ground for Production," describing the Behr-Manning methods and equipment demonstration rooms which provide facilities for manufacturers to pre-test grinding and finishing methods. C-8

Equipment for Paint Stripping

OAKITE PRODUCTS, INC., 22 Thames St., New York 6, N. Y. Booklet entitled "How to Strip Paint with Oakite Materials and Methods," describing four simplified methods of removing paint, enamels, and similar finishes from metal surfaces. C-9

Nickel Alloys

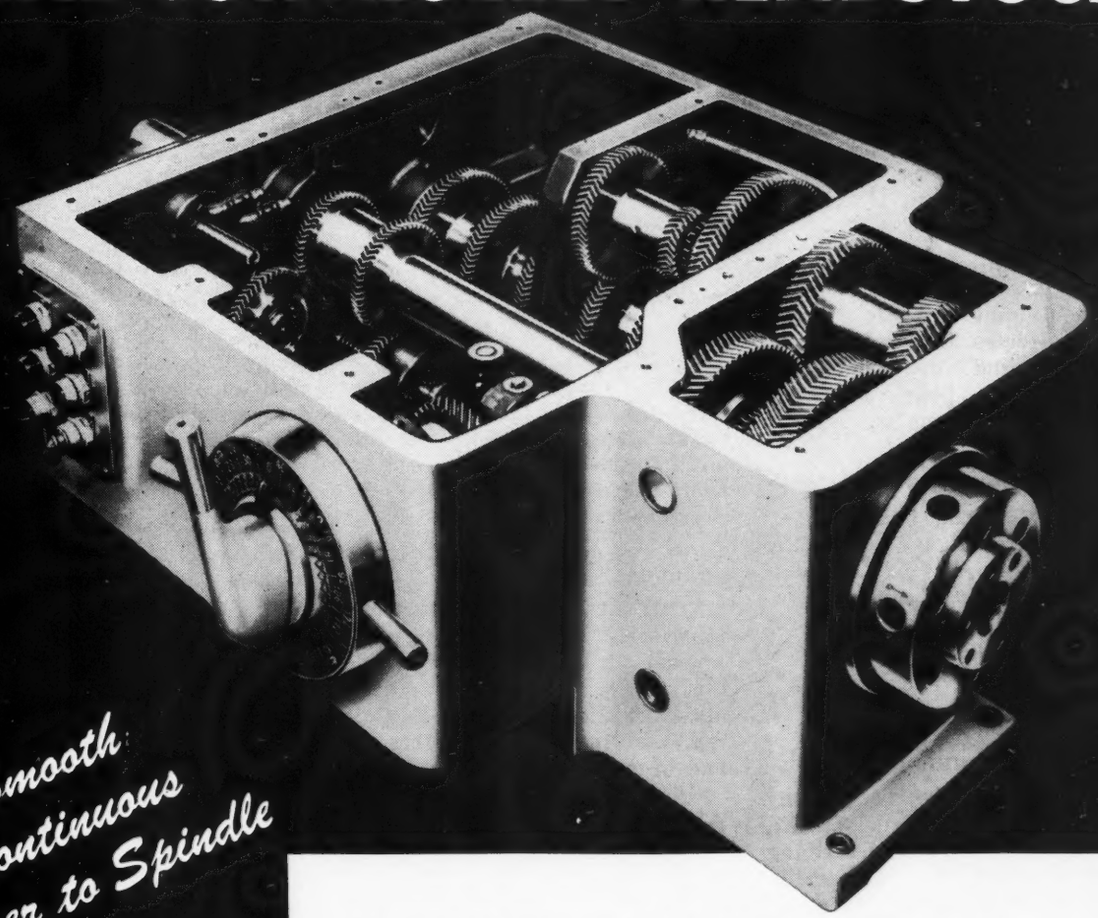
INTERNATIONAL NICKEL Co., INC., 67 Wall St., New York 5, N. Y. Technical bulletins T-7 and T-9, the first of which deals with the engineering properties of Inconel and Inconel X, and the second with the properties of K Monel and KR Monel. C-10

Multiple-Spindle Drill Heads

THRIFTMASTER PRODUCTS CORPORATION, 1014 N. Plum St., Lancaster, Pa. Booklet containing complete information on the design and construction of Thriftmaster multiple-spindle drill heads, including a new auto-reverse tap or drill unit.....C-11

To obtain copies of these publications, fill in number at end of note on Inquiry Card, page 225.

SIDNEY'S 32 SPEED DIAL CONTROLLED HEADSTOCK



Smooth Continuous Power to Spindle

The herringbone gears in the Sidney headstock provide more tooth contact resulting in greater strength, smoother action with end thrust eliminated through the double opposed helix angles. Accurate tooth contour, gradual engagement and oblique lines of contact assure correct tooth action and reduces wear to minimum. This headstock also features a spindle mounting which automatically compensates for expansion caused by temperature rise. The ideal transmission for carbide tools. The herringbone geared headstock has been an exclusive Sidney feature since 1925.

SIDNEY MACHINE TOOL COMPANY
SIDNEY Builders of Precision Machinery Since 1904 OHIO

Outstanding Tapping Operations

PRATT & WHITNEY DIVISION NILES-BEMENT-POND CO., West Hartford 1, Conn. Circular DM-12, entitled "Tap Life," presenting a number of case histories of tapping operations showing outstanding tap performance. C-12

Steel Shaft Design Data

DELAVAL STEAM TURBINE CO., IMO - DELAVAL PRODUCTS DIVISION, Trenton 2, N. J. Bulletin G-7, containing data for determining stresses, torques, bending moments, and deflections, in round, square, hollow, keyway, and stepped steel shafts.....C-13

Electric-Weld Pipe

REPUBLIC STEEL CORPORATION, 3100 E. 45th St., Cleveland 27, Ohio. Circular ADV-521, describing, step by step, the electric resistance weld method of making pipe, and giving tables of weights, dimensions, and hydrostatic test pressures. C-14

Cylindrical Grinding Wheels

SIMONDS ABRASIVE CO., Tacony and Fraley Sts., Philadelphia 37, Pa. Bulletin ESA-191, describing grinding wheels for plain cylindrical grinding. Grain and grade recommendations, wheel sizes, and data on speeds and feeds are included. C-15

Milling Machine Arbors and Adapters

SCULLY-JONES & CO., 1906 S. Rockwell St., Chicago 8, Ill. Bulletin 2-50, illustrating and describing Scully-Jones milling machine arbors and adapters, including complete specifications and prices. C-16

Fractional-Horsepower Motors

BODINE ELECTRIC CO., 2254 W. Ohio St., Chicago 12, Ill. Catalogue containing specifications on the company's line of fractional - horsepower motors, together with a listing of typical applications. C-17

Magnetic Separators

DINGS MAGNETIC SEPARATOR CO., Milwaukee 46, Wis. Catalogue C-1100-A, describing the application, operation, and design of Dings non - electric Alnico "Perma-Drum" magnetic separators. C-18

Milling Machines

KEARNEY & TRECKER CORPORATION, 6784 W. National Ave., Milwaukee 14, Wis. Bulletins CK-10 and CK-15, descriptive of the new Model CK 10-H.P., and 15-H.P. general-purpose, plain and universal milling machines. C-19

Socket Screws

BRISTOL CO., Mill Supply Division, 161 Bristol Road, Waterbury 20, Conn. Bulletin 881, containing complete information and specifications on small wire-size multiple-spline socket cap-screws and set-screws manufactured by the company. C-20

Seamless Tubing

TUBE REDUCING CORPORATION, Department DR, Wallington, N. J. Booklet 96, entitled "How to Cut Costs with Rockrite Close-Tolerance, Cold-Reduced Seamless Tubing," covering ferrous, non-ferrous, and bi-metal applications.....C-21

Alternating-Current Welders

LINCOLN ELECTRIC CO., Cleveland 1, Ohio. Bulletin 1301, describing the Lincoln 200-ampere "Fleetwelder," for alternating-current welding on light and heavy work in flat, vertical, or overhead positions. C-22

Paint Spray Booth Maintenance

OAKITE PRODUCTS, INC., 126 Thames St., New York 6, N. Y. Service Report describing specialized materials and methods for simplified maintenance of water-wash paint-spray booths.....C-23

Holder for Carbide Tools

W. H. SACKMAN CO., INC., 44 N. 4th St., Philadelphia 6, Pa. Folder describing an adjustable swing tool-holder designed to hold tools rigidly, close to the tip, which makes it especially adapted for carbide tools. C-24

Tungsten-Carbide Drill Bushings

S. & E. MACHINE PRODUCTS, INC., Bridgeport, Mich. Bulletin 102, containing complete information on the company's standard line of solid tungsten-carbide drill bushings. C-25

Precision Measuring Tools

L. S. STARRETT CO., Athol, Mass. Booklet illustrating and describing more than sixty new precision measuring tools, including micrometers, gages, squares, etc., recently introduced by the company at the ASTE Show...C-26

Thread Sizes for Various Drill Diameters

ZAGAR TOOL, INC., 23880 Lakeland Blvd., Cleveland 23, Ohio. Bulletin 506, giving thread sizes for various drill diameters applicable when drills are held in threaded adapters. C-27

External Hones

SUNNEN PRODUCTS CO., 7921 Manchester Ave., St. Louis 17, Mo. Circular X-MAN-5008, illustrating and describing the Sunnen external hone for accurately finishing external diameters in all metals. C-28

Direct-Current Motors

RELIANCE ELECTRIC & ENGINEERING CO., 1088 Ivanhoe Road, Cleveland 10, Ohio. Bulletin C-2001, containing data on the design, construction, and selection of direct-current motors ranging from 3/4 to 1000 H.P.....C-29

Twist Drills

NATIONAL TWIST DRILL & TOOL CO., Rochester, Mich. Circular announcing four new National drill sets for the tool-room, repairman, and mechanics, as well as wood boring drills for workshop, farms, etc. C-30

Welding Accessories

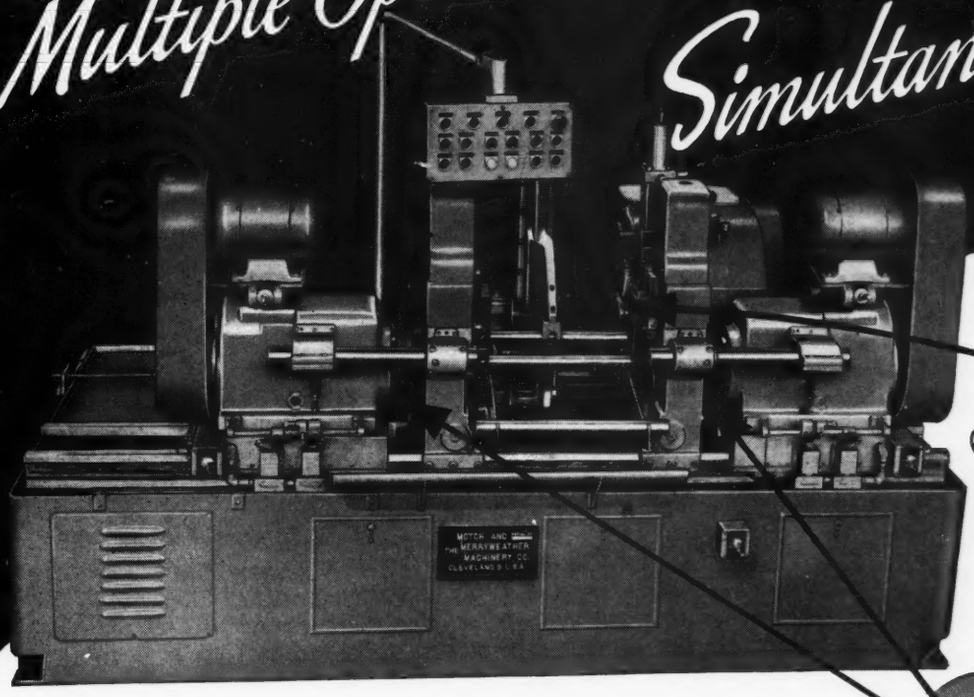
METAL & THERMIT CORPORATION, 100 E. 42nd St., New York 17, N. Y. Booklet covering the company's line of electrode-holders, helmets, clamps, goggles, protective clothing, and other arc-welding accessories. C-31

Rivets

CHICAGO RIVET & MACHINE CO., 9600 W. Jackson Blvd., Bellwood, Ill. Catalogue listing various types of tubular and split rivets made by this company, including engineering information and prices. C-32

To obtain copies of these publications, fill in number at end of note on Inquiry Card, page 225.

UNITIZE *Multiple Operations!* CUT OFF TO LENGTH AND MACHINE BOTH ENDS — *Simultaneously*

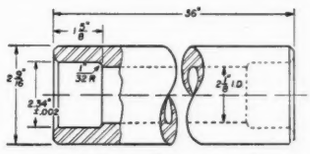


1 Cuts Off to Length

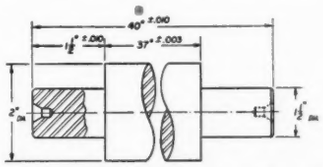
Capitalize on Motch & Merryweather's fast accurate circular sawing by combining it with simultaneous double-end machining operations. Save handling and floor space! Increase output and reduce cost! Unitize your production.

* * *

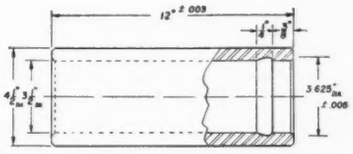
Write for further information.



Operation: Cut off; bore and chamfer inside and outside, both ends.
Material: SAE 1020 steel tubing.
Production: 140 pcs/hr. @ 100% eff.



Operation: Cut off; hollow mill and center drill both ends.
Material: C 1117 cold drawn steel.
Production: 84 pcs/hr. @ 100% eff.



Operation: Cut off; face and chamfer both ends; internal groove one end.
Material: C 1015 seamless steel tubing.
Production: 110 pcs/hr. @ 100% eff.

2 Machines Both Ends

- Chamfers both ends
- Center drills both ends
- Center drills and chamfers both ends
- Threads both ends
- Turns one or both ends (box tool)
- Chamfers O. D. and I. D. of tubing
- Reams one or both ends of tubing
- Chamfers O. D. and reams both ends of tubing
- External grooves and chamfers one or both ends
- Internal grooves, faces and chamfers O. D. and I. D. one or both ends of tubing

Manufactured by

THE MOTCH & MERRYWEATHER MACHINERY COMPANY
715 PENTON BUILDING • CLEVELAND 13, OHIO
Builders of Circular Sawing Equipment, Production Milling, Automatic and Special Machines

PRODUCTION-WITH-ACCURACY MACHINES AND EQUIPMENT

Beryllium-Copper Applications

BERYLLIUM CORPORATION, Reading, Pa. Technical bulletin No. 1, describing a case history of the application of Berylco leaf springs in the manufacture of Delta-Star air switches. C-33

Deep-Drawn Pressed Steel Products

AMERICAN CAR & FOUNDRY CO., 30 Church St., New York 8, N. Y. Circular showing typical examples of deep-drawn carbon and stainless steel pressed products made by the concern. C-34

Welding of Copper

AMPCO METAL, INC., 1745 S. 38th St., Milwaukee 46, Wis. Reprint of material from the Welding Handbook of the American Welding Society covering the welding of copper and copper alloys. C-35

Tool and Die Welding Electrodes

WELDING EQUIPMENT & SUPPLY CO., 223 Leib St., Detroit 7, Mich. Catalogue containing 56 pages of information on the Eureka line of tool and die welding electrodes. C-36

Renewable Fittings for Flexible Hose

ECLIPSE - PIONEER DIVISION, BENDIX AVIATION CORPORATION, Teterboro, N. J. Folder descriptive of a new series of mechanical type renewable fittings for flexible metal hose. C-37

Mercury Clutches

AUTOMATIC STEEL PRODUCTS, INC., Canton, Ohio. Bulletins describing the Mercury clutch and its application in gasoline engines, electric motors, air-conditioning equipment, and many other machines. C-38

Air Pumps

LEIMAN BROTHERS, INC., 194-F Christie St., Newark, N. J. Catalogue descriptive of the Leiman line of air pumps, including performance curves and tables of specifications. C-39

Non-Metallic Blast Grit

AMERICAN WHEELABRATOR & EQUIPMENT CORPORATION, 749 S. Byrkit St., Mishawaka, Ind. Bulletin describing the properties of "Black Beauty" non-metallic, silica-free blast grit. C-40

Automatic Screw Machines

CLEVELAND AUTOMATIC MACHINE CO., Cincinnati 12, Ohio. Bulletin describing and illustrating the Model A improved 3 3/4- and 5 3/4-inch single-spindle automatics. C-41

Arc Welding

AIR REDUCTION SALES CO., 60 E. 42nd St., New York 17, N. Y. Pamphlet ADR-65, containing a reprint of an article entitled "Arc Welding in Railroad Shops," from the *Welding Journal*. C-42

Thread and Form Rolling

REED ROLLED THREAD DIE CO., 237 Chandler St., Worcester 2, Mass. Bulletin 5-2, describing the thread and form rolling process—its application and the equipment employed. C-43

Pipe and Tube Bending

WALLACE SUPPLIES MFG. CO., 1300 Diversey Parkway, Chicago 14, Ill. Fiftieth anniversary catalogue containing sixty pages of data on the bending and fabricating of pipe and tubing. C-44

Vises

WILTON TOOL MFG. CO., 925-941 Wrightwood Ave., Chicago 14, Ill. Catalogue 101E, on Wilton vises of various types, C-clamps, work positioners, etc. C-45

Blackening Processes

ENTHONE, INC., 442 Elm St., New Haven, Conn. Bulletin covering Ebonel blackening processes for steel, copper, brass, and zinc. C-46

Air Gages

TAFT-PEIRCE MFG. CO., Woonsocket, R. I. Catalogue 610, containing complete information on the Taft-Peirce "Compairator" air gage. C-47

Disk Grinders

MATTISON MACHINE WORKS, Rockford, Ill. Bulletin 546-2RM, containing specifications on the Mattison Hanchett type single-spindle disk grinders. C-48

Metallizing for Corrosion Prevention

METALLIZING ENGINEERING CO., INC., 38-14 Thirtieth St., Long Island City 1, N. Y. Bulletin 93, entitled "Corrosion Prevention with the Metco Metallizing Systems." C-49

Plastic Cutting Blocks for Dies

COLONIAL RUBBER CO., Ravenna, Ohio. Leaflet 89, descriptive of Colonial Tygon plastic cutting blocks for use with dies employed in cutting various types of materials. C-50

Multiple V-Drives

MAUREY MFG. CORPORATION, 2915 S. Wabash Ave., Chicago 16, Ill. Bulletin MVD-1000, completely describing the company's line of multiple V-drives. C-51

Felt Machine Mountings

WESTERN FELT WORKS, 4029 Ogden Ave., Chicago, Ill. Booklet describing "Westsorb" vibration absorbing felt pads for machine mountings. C-52

Universal Joints

B. M. ROOT CO., York, Pa. Bulletin 185, giving dimensions, horsepower, and torque for the various sizes and types of Root universal joints. C-53

Abrasive Hones

MID-WEST ABRASIVE CO., Owosso, Mich. Folder descriptive of the Micro-X and Micro-EE abrasive hones. C-54

* * *

New Steel Developed to Use Less Columbium

An anticipated shortage of the comparatively rare alloying element columbium, or niobium as it is now known, has led to the development of a new low-carbon stainless steel for wide industrial use. Carbon in stainless steel is an element of vulnerability when the steel is subjected to conditions which promote intergranular corrosion. Up to a few months ago columbium or titanium was used to minimize that vulnerability, particularly at elevated temperatures. Now the carbon content of such steels is 0.03 per cent or lower.

To obtain copies of these publications, fill in number at end of note on Inquiry Card, page 225.

By E. S. Salichs

BETWEEN GRINDS

Americana in Steel

In 1644, America's first producing iron works of which there is a record, was set up on the sloping west bank of the little Saugus River in Massachusetts. Today, *"Steelways"* tells us, steelmen have joined forces with Saugus townfolk to reconstruct the old ironworks. Before rebuilding, historians are running down clews hidden in ancient documents of this country and England (the "Company of Undertakers for the Iron Workes" was organized and financed in England) while archeologists are digging the ruins. Note: Any barbecue forks uncovered belong to this generation.

A Jump for a Pump

"Pretty Pilot Picks up Pump with Plater's Private Plane"—that isn't a nursery rhyme but the title of a release from the Worthington Pump and Machinery Corporation telling the story of a pump needed at their Olean plant and a local aviatrix who hopped down to Newark for it. Perhaps plumbers should pilot planes too.

Hammock in Hat

A "Roughneck" metal safety hat which absorbs shock by means of a suspension hammock in an inner hat assembly, has been marketed by E. D. Bullard Co. If you hang your hat on a clothes tree, does the hammock start swinging?

From Tool Kit to Parlor Table

A case where MACHINERY'S HANDBOOK, frequently referred to as the "Bible of the mechanical industry," has taken on a function usually reserved for the Family Bible, came to light when one of our salesmen sold the latest edition to an elderly buyer in Cleveland. The latter commented: "It will take some time to transfer my family history, births, etc., which have been recorded in my old HANDBOOK through the years."

Drums Rolling Along

A Dutch manufacturer has constructed a mobile drum factory to serve remote regions. The itinerant factory, capable of producing drums and barrels anywhere, comprises some thirty units (trucks and trailers on which the machinery and work shop are mounted) and is provided with an electricity generating plant as well as living accommodations for the workers. The shop superintendent is writing his memoirs, "Around the World in a Drum Factory."

Deburring — in a Nutshell

Packard Motor Car Co. is using finely ground walnut shells as "shot" for blasting tiny metallic burrs off machined surfaces of Ultramatic Drive castings. Each piece of shot is exactly 1/32 inch in diameter and strikes the casting at a velocity of over 2 miles a minute. Packard's weekly consumption of walnut shells averages nearly 160 pounds. We're shellbound!

COOPERATIVE CORRESPONDENT—Wilton F. Hoag saw some reference on this page to one of our twenty-five year subscribers and promptly informed us that he has been an enthusiastic reader of MACHINERY for nearly forty-five years, "never missing an issue and maintaining a clipping file of pages from each." He is looking forward to twenty-five more years of receiving the magazine—since we have some members in our fifty-year club, this is by way of an announcement that Mr. Hoag is off to establish the record. There is no problem with this

apple-pie mail; we jumped to ask Mr. Hoag for his pix and a few details of his career, to present here and now: Mr. Hoag, who lives in Batavia, Ill., has his own company, designing and building special machinery, jigs, dies, tools, gages, and fixtures. His past activities have covered gas and steam engine manufacture, railroading, power-house operation, as well as time ticked at a watch factory while a youngster. And in keeping with his keen interest in mechanical progress, W.F.H. is a member of A.S.M.E., A.S.T.E., and A.S.M.

News of the Industry

Alabama

ROYDEN C. PRESLEY has been appointed district sales manager of the Birmingham, Ala., area of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. He succeeds C. H. VAUGHAN, who recently resigned. Mr. Presley was manager of the Toledo, Ohio, district sales office prior to his present appointment.

WESTINGHOUSE ELECTRIC CORPORATION, Pittsburgh, Pa., announces that it has started construction on a repair plant at Birmingham, Ala. The new plant will be located at Third Ave., S., between 33rd and 34th Sts.

Illinois and Indiana

JOHN F. MILLER has been elected vice-president of the Illinois Tool Works, Chicago, Ill. He joined the company last September as manager of the company's Tool Division. In his new position, he will continue to have charge of the engineering, manufacture, and sale of the company's standard and special metal-cutting tools, and will also direct the development and marketing of the company's new line of graphic inspection equipment.

IRVING M. MALSCH has been appointed Chicago district sales manager by the Bridgeport Brass Co., Bridgeport, Conn., taking the place of CARL P. QUANZ, who has been promoted to plant manager of the company's Indianapolis mills. Mr. Malsch, in addition to his sales activities, will be responsible for the operation of the Chicago warehouse. DAVID L. NESLER has been made Indianapolis district sales manager, the position vacated by Mr. Malsch.

WALTER F. STEGNER Co., selling agent for a number of machinery concerns, including the Cleveland Twist Drill Co., Weldon Tool Co., Threadwell Tap & Die Co., and Sellers Division of Consolidated Machine Tool Corporation, announces that the company has moved from 20 N. Wacker Drive, Chicago, Ill., into a new building of its own at 4716 W. Addison St., Chicago.

ALLEN P. BECKLOFF has been appointed manager of the Tubular Products Division of Joseph T. Ryerson & Son, Inc., Chicago, Ill. He was previously manager of the tubular products department of the Cleveland plant. In his new position, he succeeds R. W. BURT, who was recently appointed Chicago plant sales manager.

V & O PRESS CO., DIVISION OF ROCKWELL MFG. Co., Hudson, N. Y., has appointed the FEDERAL MACHINERY SALES Co., 4639 Washington Blvd., Chicago 44, Ill., distributor for the V & O line of power punch presses, automatic feeds, Feed-O-Matics, and metal forming equipment.

R. W. JOHNSON has been appointed director of sales of the Industrial Gear Division of Foote Bros. Gear & Machine Corporation, 4545 S. Western Blvd., Chicago, Ill. For the last year he has been associated with the Bearing Engineering Co., San Francisco, Calif.

ARTHUR B. HAGAN & ASSOCIATES, 3851 N. Hoyne Ave., Chicago, Ill., have been appointed direct factory representatives for the HYPRO-TOOL Co., New Bedford, Mass., and will maintain a complete stock of Hy-Pro high-speed taps for the convenience of users in the area.

BURGESS-PARR Co., Freeport, Ill., manufacturer of the corrosion-resistant alloy known as "Illium," announces that the name of the company has been changed to the ILLIUM CORPORATION, in order to identify the company better with its principal product.

KEITH J. BROWNELL has been appointed sales manager of the Bearing Division of the McGill Mfg. Co., Inc., Valparaiso, Ind. For the last three and a half years, he has held the position of assistant sales manager of the division.

M. P. DEBLUMENTHAL has been made assistant chief research engineer of the Studebaker Corporation, South Bend, Ind.

Massachusetts and Connecticut

FRANCIS E. FAIRMAN, JR., has been named general sales manager of the Large Apparatus Divisions of the General Electric Co., Pittsfield, Mass., and ARTHUR W. BARTLING general

(Left to Right) Francis E. Fairman, Jr., general sales manager of Large Apparatus Divisions of General Electric Co.; Arthur W. Bartling, general sales manager of Small Apparatus Divisions; and Robert C. Hanna, manager of sales of Fractional-Horsepower Motor Divisions

sales manager of the Small Apparatus Divisions. Mr. Fairman was previously manager of sales of the Transformer and Allied Product Division of the company, and will be succeeded in that position by WILLIAM S. GINN, assistant sales manager. ROBERT C. HANNA has been appointed manager of sales of the Fractional-Horsepower Motor Divisions at Fort Wayne, Ind., the post formerly occupied by Mr. Bartling.

FLOYD C. PICKETT has been appointed assistant to the works manager of the Fitchburg, Mass., Works of the General Electric Co. He will be responsible for labor relations and service functions. Mr. Pickett has been works superintendent for the last two years.

NEW DEPARTURE DIVISION, GENERAL MOTORS CORPORATION, Bristol, Conn., announces the retirement of the following men: NEWTON D. HOWELL and CLIFFORD N. HOUSE, ball-bearing sales engineers at the Detroit office; ALWIN A. GLOETZNER, manager of the southeastern zone at Washington, D. C.; and GEORGE A. ELLIS, sales representative for New Departure bicycle coaster brakes in the southeastern states.

Michigan and South Dakota

MICRO DRILL GUIDE & ENGINEERING Co., 18515 Weaver Ave., Detroit 28, Mich., has entered the micro-drilling equipment field with a complete line of over 1700 types of standardized micro-drill jig bushings and liners for all types of small-hole drilling operations. The new company has been founded by R. A. THOMPSON and E. R. DALY, both of whom were formerly with Colonial Bushings, Inc. A drill jig is also manufactured by the company to make possible rapid and accurate set-up of the micro-drill guides.

MID-WEST ABRASIVE Co. announces that production on a new abrasive grain for use in making grinding wheels and sandpapers will start about September 1 with the completion of the company's new plant at Owosso, Mich. The new grain plant is 342 feet long by 72 feet wide and contains more than 100,000 square feet of floor space.

GRANT S. WILCOX, formerly chairman of the Detroit Chapter of the American Society of Tool Engineers and a past national director of that society, has been elected president of the Engineering Society of Detroit. Mr. Wilcox is assistant factory manager of the Plymouth Division of the Chrysler Corporation.

TAFT-PEIRCE MFG. Co., Woonsocket, R. I., has opened a direct sales office in Detroit, Mich., located in the A.S.T.E. Building at 10700 Puritan Ave. The office will be headed by RAYMOND F. JALBERT, district manager of the Detroit territory, with RICHARD READ as assistant.

J. M. BERTOTTI, for the last four years manager of training for the Carboloy Company, Inc., Detroit, Mich., has been named assistant sales manager. R. G. BRIERLEY becomes manager of training in Mr. Bertotti's place.

REED ROLLER BIT Co., CLECO DIVISION, manufacturer of air tools, airline couplings, valves, chisels, etc., announces the opening of a new factory branch and warehouse at 2832 E. Grand Blvd., Detroit, Mich.

EDWARD S. WALTZ has been made district manager of the Detroit branch of Wheelock, Lovejoy & Co., Inc., succeeding C. ROBERT JENKS, who retired in June after twenty-five years of service with the company.

JOHN C. COONLEY has been appointed assistant manager of the Valve Division of the American Car & Foundry Co., New York City. His headquarters will be in Detroit, Mich.

DON C. STABLEIN has been appointed general sales manager of the K. O. Lee Co., Aberdeen, S. D., manufacturer of machine tools and automotive maintenance equipment. He will succeed DON T. LYONS, who recently resigned to become general sales manager of the Bishman Mfg. Co., Osseo, Minn.

New Jersey

EDGAR H. MILLER has been elected president of the Packing Engineering Corporation, Cranford, N. J., manufacturer of mechanical packings and lubricants used in the process and petroleum industries. WINCHESTER BRITTON, JR., son of one of the founders of the concern, who has been affiliated with the company for the last twenty years as secretary-treasurer, has sold his interest in the firm and has become treasurer of Advent Associates, Inc., Morris and Union Aves., Elizabeth 3, N. J., an industrial advertising concern.

LLOYD C. SMITH, vice-president and general manager of the Ohio branch of the Heller Brothers Co., has been promoted to the office of vice-president in charge of sales of the parent company, with headquarters at the main offices in Newark, N. J.

RAYMOND H. CRAMER has been made general manager of the Hyatt Bearings Division of General Motors at Harrison, N. J., succeeding the late H. O. K. Meister. Mr. Cramer has been works manager of the division since 1942.

New York

D. E. MOORHEAD has been appointed administrative assistant to the manager of Small and Medium Motor Divisions of the General Electric Co., Schenectady, N. Y. O. F. VEA has been made manager of sales, and F. B. HORNBY manager of engineering. HARRISON D. BEALE has been appointed manager of the Renewal Parts Division, Industrial Divisions, of the company's Apparatus Department.

HORACE ZIMMER, New York district manager for the General Electric Co.'s Apparatus Department, has been appointed manager of districts for the department. FRANK A. FARON becomes New York district manager in his place. A. K. BUSHMAN has been made manager of industry divisions of the same department. Mr. Bushman's headquarters will be at Schenectady, N. Y.

LOUIS R. BOTSAI has been appointed manager of the Motor and Control Division at the Buffalo plant of the Westinghouse Electric Corporation. Mr. Botsai, who joined the company in 1915, had been manager of the Gearing Division in Pittsburgh since 1941. He succeeeds LEON R. LUDWIG, who has been appointed to the staff of JOHN K. HODNETTE, vice-president.

E. J. KOLB has been appointed manager of export sales for the Crucible Steel Co. of America, 405 Lexington Ave., New York 17, N. Y. He will continue to be located at the company's headquarters in New York City, where he has served as assistant manager of export sales for the last nine years.

DELAVAL SEPARATOR Co. announces that plans have been completed to move the executive staff and general office of the company from New York City to Poughkeepsie, N. Y. Construction has been started on a new general office building which will be located a short distance from the DeLaval factory.

EMIL P. KNAPP, for the last five years assistant chief engineer at the Kollsman Instrument Division of the Square D Co., Elmhurst, N. Y., manufacturer of aircraft and optical instruments, has been appointed chief product engineer of the organization.

B. S. LIVINGSTON, 50 Broadway, New York City, president of the export firm of Livingston & Southard, Inc., has recently set up an office as export consultant to advise American manufacturers and producers on export trade.

CHARLES F. STEIN has joined the Doehler-Jarvis Corporation, New York City, in the capacity of general

purchasing agent. He previously held a similar position with the Kaiser-Frazer Corporation at Willow Run, Mich.

CARBET, INC., 111 Broadway, New York 6, N. Y., has been appointed eastern representative for the FEDERAL MACHINE & WELDER CO., Warren, Ohio, manufacturer of welding equipment and Warco presses.

AIR REDUCTION SALES CO., DIVISION OF AIR REDUCTION CO., INC., 60 E. 42nd St., New York 17, N. Y., has been appointed national distributor for the welding industry of the recently introduced "Prepo" torch.

TRIPLEX MACHINE TOOL CORPORATION, World-Telegram Bldg., New York City, has been appointed domestic sales representative for the NATIONAL BROACH & MACHINE CO., Detroit, Mich.

F. F. ROEHLL has been appointed national sales manager of the Eutectic Welding Alloys Corporation, New York City, manufacturer of welding rods, electrodes, and fluxes.

JOHN F. MYERS has been elected president of the Westinghouse Electric Supply Co., New York City, succeeding DAVID M. SALSBURY.

Ohio

AMERICAN STEEL & WIRE CO., Cleveland, Ohio, announces the establishment of separate Advertising and Market Development Divisions in the general sales department of the company. Appointed as manager of the Advertising Division is O. B. STAUFFER, and as manager of the Market Development Division, JOHN E. MCGRATH. WILMER H. CORDES has been named general staff manager of the company's sales department, succeeding PAUL L. LINDSAY, recently appointed Cincinnati district manager of sales. Mr. Lindsay takes the place of THOMAS M. CAMERDEN, who has been named Pittsburgh district manager of sales to fill the position left vacant by the death of J. J. Reagan.

COUSINO METAL PRODUCTS, INC., Toledo, Ohio, has taken over all the facilities and personnel of COINEX, INC., also of Toledo. Cousino Metal Products, Inc., will continue to produce small and medium-sized precision stampings and coined metal parts. Two plants will be maintained in Toledo, one at 3023 Monroe St. and the other at 2505 Albion St. The general offices will be located at the latter address. The officers of the combined organizations are WALTER F. COUSINO, president; LLOYD A. KELLEY, vice-president; and E. C. WASSERMAN, vice-president, secretary, and treasurer.

LODGE & SHIPLEY CO., Cincinnati, Ohio, has announced the following new distributors for its complete line of lathes: GILLES MACHINERY CO., 812 Huron Road, Cleveland, Ohio; JOHN E. LIVINGSTONE CO., 16516 James Couzens Highway, Detroit, Mich.; EDMOND E. BURKE CO., 17 Seventeenth St., Toledo, Ohio; STRAUSS & HASS, INC., 524 Camp St., New Orleans, La.; PEERLESS SUPPLY CO., INC., 701 Spring St., Shreveport, La. It is also announced that sales and service in the Cincinnati area will be handled directly by the factory office at 3055 Colerain Ave., Cincinnati.

CHARLES R. BEESON has been appointed vice-president of the Ohio Stainless & Commercial Steel Co., Cleveland, Ohio, distributor of carbon and alloy bars, sheets, and other steel products. He has been associated with the company in various sales capacities since its formation in 1946, and prior to that was affiliated with the Fisher Body Division of the General Motors Corporation, Detroit, Mich.

ANDREW E. O'LEARY has been transferred from St. Louis to Cleveland to direct the eastern Ohio sales of the high-speed radial saws manufactured by De Walt, Inc., a subsidiary of the American Machine & Foundry Co., New York. He will also direct the sales of the AMF industrial "Lowerator" and the Wahlstrom chuck.

LEWIS W. LAMMIMAN has been made technical service manager of the Paint Spray Division of the DeVilbiss Co., Toledo, Ohio. JOHN W. COCHRUN, formerly with the Bendix-Westinghouse Automotive Air Brake Co., has been given the newly created position of equipment service manager.

KEPLER ENGINEERING CO., 451 W. Market St., Akron, Ohio, has been appointed representative in the state of Ohio and northern Kentucky for the line of air and hydraulic cylinders made by the HYDRO-LINE MFG. CO., Rockford, Ill.

E. B. WHITTEMORE has been made manager of the Specialty Spring Steel Department of the Cold Metal Products Co., Youngstown, Ohio, manufacturer of precision cold-rolled strip steel.

PAUL H. DAVEY, JR., has been elected vice-president in charge of production of the Davey Compressor Co., Kent, Ohio. Mr. Davey has been production manager of the Davey plant for the last two years.

ROBINS CONVEYORS DIVISION, HEWITT-ROBINS, INC., has moved its Cleveland office from 215 Rockefeller Bldg., to 8905 Lake Ave.

George Carleton, Jr., recently elected president of the Nice Ball Bearing Co.

Pennsylvania and Maryland

GEORGE CARLETON, JR., has recently been made president of the Nice Ball Bearing Co., Philadelphia, Pa., succeeding W. H. ROSSMASSLER, who has retired. Mr. Carleton has been associated with the company since 1929, serving successively as sales manager. vice-president, and executive vice-president.

BABCOCK & WILCOX TUBE CO., Beaver Falls, Pa., has announced plans for the erection of a $1,000,000 extrusion plant to be used for the fabrication of tubes of various metals and alloys in complex sectional shapes. The announcement followed the completion of a licensing agreement from a French concern who developed the process and hold patent rights.

FRANK J. MEYER has been made district manager of sales of the Pittsburgh office of Lukens Steel Co., Coatesville, Pa., succeeding W. HARRISON LACKEY, who has been transferred to the home office. CHARLES A. REA, previously located at the Coatesville district sales office, will take Mr. Meyer's former position on the Philadelphia sales staff.

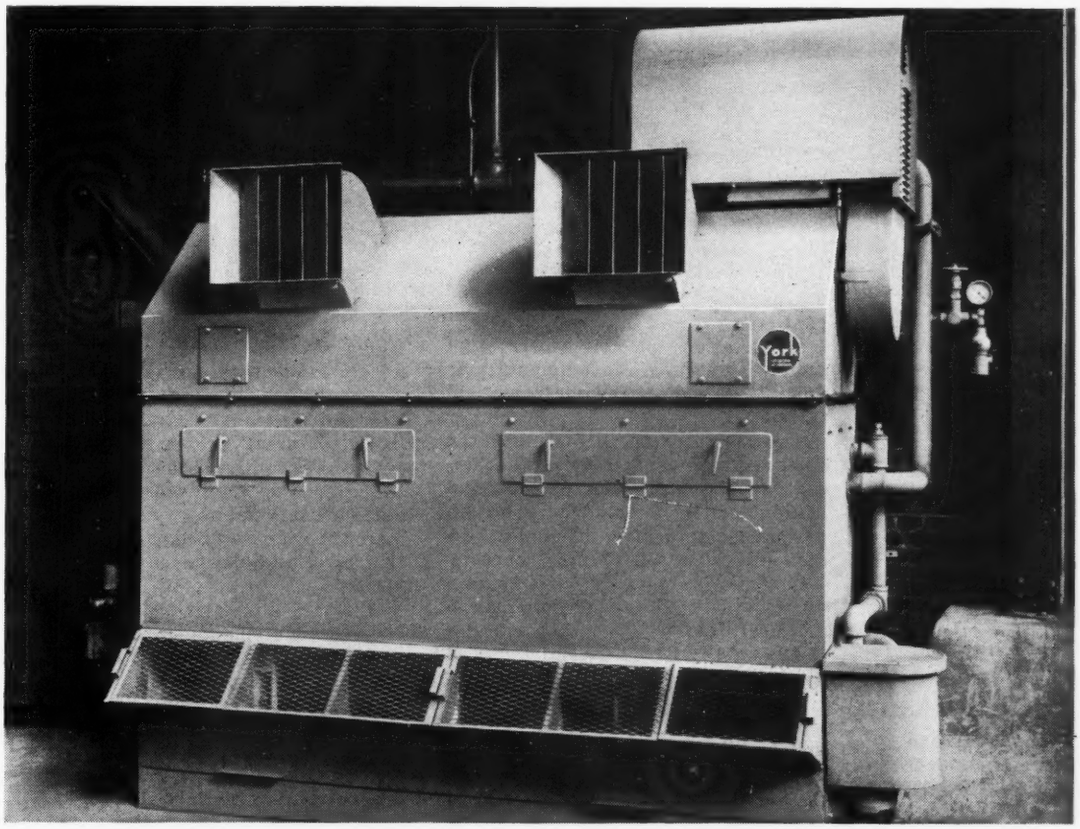
GEORGE P. THOMAS, JR., has been elected vice-president of the Thomas Machine Mfg. Co., Pittsburgh, Pa. Mr. Thomas, who is purchasing agent for the company, will continue in this capacity in addition to filling his new duties as vice-president.

TOPFLIGHT TAPE CO., manufacturer of printed, pressure-sensitive tapes, announces that all the administrative, sales, order, accounting, and advertising departments are now located at 116 E. Market St., York, Pa.

TO OWNERS OF AIR CONDITIONING AND REFRIGERATION EQUIPMENT . . .

Worried Over Water

The York Water Economizer, equipped with Revere Copper and Brass Fittings to guard against corrosion and assure trouble-free operation, will save you up to 95% on water.



FOR many years Revere has furnished the York Corporation, York, Pa., with copper and brass for use in its air conditioning, refrigeration and heating equipment. Engineers at York tell us that during that time they have learned to depend on Revere Products for high quality and uniformity of metal, correct temper, and strict adherence to specifications.

It was this satisfaction with Revere over the years that led York engineers to specify Revere Products for the York Water Economizer. The brass spray nozzles and copper water and refrigeration tube with which this unit is equipped assure constant, trouble-free protection against that efficiency-destroyer which is ever-present when water and metals get together . . . corrosion.

This is a mighty important thing for York, and a mighty important thing for present and prospective owners of air conditioning and refrigeration equipment. The York Economizer itself is a mighty important unit right now, too. For, with water a most critical item in many sections of the country, both from the standpoint of supply and disposal facilities, the York Water Economizer makes it possible to save up to 95% of the amount of water normally required. On a typical installation of 100 tons of refrigeration capacity, for example, 17,100 gals. of water can be saved every hour of operation!

York also uses Revere Copper and Brass products in its water coolers, for cooling coils, chilled water piping, and other component parts of its air conditioning systems.

Perhaps there is a Revere Metal or alloy that you can use to advantage in your product. Why not call the nearest Revere Sales Office and see?

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

GEORGE I. BOTTCHER has been appointed chief engineer of the Allegheny-Ludlum Steel Corporation, Pittsburgh, Pa. J. F. CHAPMAN and R. E. SMITH have been made assistants to Mr. Bottcher.

KENNAMETAL, INC., Latrobe, Pa., has added two new members to its board of directors—GEORGE T. KERNS, treasurer of the company since its incorporation in 1943, and GEORGE G. SCHUSTER.

RALPH F. KOENEMAN has been appointed chief engineer of passenger car engineering at the Berwick, Pa., plant of the American Car & Foundry Co.

Charles R. Robison newly appointed general sales manager in Baltimore area for Dayton Rogers Mfg. Co.

CHARLES R. ROBISON has been appointed general sales manager in the Baltimore area for the Dayton Rogers Mfg. Co., Minneapolis, Minn. His headquarters will be at 15 S. Gay St., Baltimore 2, Md.

* * *

Correction

George O. Hendee, sales and service engineer in the Philadelphia area for the Hannifin Corporation, Chicago, Ill., has been transferred to the New England territory to take the place of Elliott D. Thompson. Mr. Hendee will make his headquarters at Worcester, Mass., not Rochester, Mass., as stated in July MACHINERY. He is succeeded at Philadelphia by Joseph O'Malley.

* * *

In a normal season on the Great Lakes, a single iron ore vessel will travel 50,000 miles and transport 500,000 tons of iron ore.

New Books and Publications

KENT'S MECHANICAL ENGINEERS' HANDBOOK. Edited by J. Kenneth Salisbury. Two volumes—one, 1611 pages, and the other 1409 pages, 5 5/8 by 8 5/8 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $8.50 each volume.

The twelfth edition of this well-known handbook, which has just been published, contains material contributed by 172 authorities in different fields. The amount of material is so great that the work is published in two volumes. The first volume is devoted to the subject of power, and the second to design and production.

The volume on power covers the basic components of any power process (air, fuel, heat, and steam); service functions—pumping and piping; power producing equipment (boilers, turbines, condensers, and gas turbines); refrigeration, heating, ventilating, and air-conditioning; transportation; electric power; and atomic energy; instrumentation; power test codes; and mathematical tables.

The second volume discusses the design and manufacture of machinery, appliances, and mechanical equipment. It covers the selection of materials; design principles; design and selection of machine components; production processes; production plant equipment; and mathematical data.

Among the new material included in this edition are plastics, molding, industrial electronic control, precision investment casting, powder metallurgy, hydraulics, and quality control.

POWER PRESS HANDBOOK. 717 pages, 4 1/2 by 7 1/4 inches. Published by the E. W. Bliss Co., Handbook Department, Toledo 7, Ohio. Price, $7.50.

This handbook for the pressed-metal working industry has just been brought out in a new edition which has been completely revised and enlarged. It is of particular interest to users of Bliss presses, but is also intended to serve as a guide to engineers, production executives, and students concerned with the operation of presses and dies in the manufacture of pressed-metal products.

There are six sections in the handbook: The first illustrates and describes the four primary sheet-metal working operations—blanking, forming, drawing, and squeezing—and gives recommended procedures for selecting the proper press for a given job, as well as pressure capacity charts, formulas, etc. The second contains illustrations and descriptive matter covering the complete range of Bliss presses and their application. Section III deals with the operation and design features of Bliss-Marquette die cushions. The operation and maintenance of the various types of presses built by the company and its subsidiaries are covered in Section IB, and a reference table, giving comparative press numbers, shaft diameters, tonnage ratings, and other data applying to these presses is given in Section V. The sixth and last section contains a glossary of terms and expressions used in the pressed-metal working industry.

INDUSTRIAL INSPECTION METHODS. By Leno C. Michelon. 566 pages, 6 by 9 1/4 inches. Published by Harper & Brothers, 49 E. 33rd St., New York 16, N. Y. Price, $6.

The first edition of this work, which was published in 1942, was widely used both in war training courses and in industry. During the war and since, industrial inspection has made great strides. The present revised edition has been brought out to cover the improved techniques, standardization, new devices, and statistical quality control methods that have been developed during this period.

It covers all major aspects of precision measurements as they are employed today. The five sections of the book deal with the following: Basic concepts in Industrial Inspection; Dimensional Control; Testing for Physical and Mechanical Properties; Surface Inspection Methods; and Inspection Organization and Personnel. The various precision and non-precision tools used in inspection work are fully described, and their correct use illustrated. An appendix contains a bibliography, a list of manufacturers' catalogues and technical bulletins, as well as motion pictures relating to this subject, and tabular matter.

MATERIALS ENGINEERING OF METAL PRODUCTS. By Norman E. Woldman. 583 pages, 6 by 9 inches. Published by the Reinhold Publishing Corporation, 330 W. 42nd St., New York 18, N. Y. Price, $10.

Industrial designers, metallurgical engineers, mechanical engineers, and others concerned with the writing of material specifications will be interested in this new work on materials engineering. The purpose of the volume is to help the materials engineer select the type of metal or alloy

THERE'S MORE TO THIS PICTURE

than first meets the eye. You'll find the entire illustration from which this enlargement was made on Page 299.

"Close-ups"

. . . show you what goes on at Allied. Plant photographs, illustrating a wealth of modern equipment in four large factories, could only tell a small part of the story. You have to get *close* to many individual operations—in production, engineering or even clerical departments—to see the true picture of Allied's careful attention to even relatively unimportant details . . . all of which add up to good products and good service.

At Allied every phase of every job is *important*.

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HARDENED AND PRECISION GROUND PARTS • STANDARD CAP SCREWS • SPECIAL COLD FORGED PARTS • SHEET METAL DIES FROM THE LARGEST TO THE SMALLEST • ALLITE ZINC ALLOY DIES • JIGS • FIXTURES • R-B INTERCHANGEABLE PUNCHES AND DIES

best able to meet a particular class of service or set of conditions.

The materials are discussed under four general classifications: Those for light-weight construction, including aluminum and magnesium alloys and stainless steel; materials for mechanical products, such as gears, springs, bearings, and threaded fasteners; materials for the electrical industries; and materials for severe service, including corrosion- and high-temperature-resistant metals. The last section deals with the testing of metals by both mechanical and non-destructive means. An appendix contains 49 pages of tables on the properties of materials.

PRACTICAL IDEAS FOR MACHINISTS. Edited by H. E. Linsley. 268 pages, 6 3/4 by 10 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $4.50.

This book comprises a compilation of articles published originally in the Practical Ideas Department of the *American Machinist*. It contains many time- and money-saving ideas for tool designers, shop superintendents, foremen, and machinists. Simple but ingenious applications of conventional machines and equipment are described, together with unusual method of solving difficult operations encountered in the machine shop. The suggestions apply to various types of machine tools, lay-out and bench work, repair and maintenance jobs, and welding, brazing, and soldering.

EFFICIENT MILLING. 28 pages, 11 by 8 1/2 inches. Published by the Metal Cutting Tool Institute, 405 Lexington Ave., New York 17, N. Y. Price, $1.

This pamphlet—a report of the Research and Technical Committee of the Milling Cutter Division of the Metal Cutting Tool Institute—contains the results of a study of materials for milling cutters, intended to guide both the cutter manufacturer and the cutter user in applying available tool materials. The subject is divided into five sections as follows: The Over-all Economics of Milling Operations; General Characteristics of High-Speed Steels, Cast Cutting Alloys, and Carbide Tool Materials; Selection of a Suitable Tool Material for a Given Milling Application; Problems Involved in Manufacture, Maintenance, and Handling of Cutters Made of High-Speed Steels, Cast Cutting Alloys, or Carbide Tool Materials; and Speeds, Feeds and Horsepower for Milling Cutters.

MANUAL OF ELECTRIC INSTRUMENTS. 150 pages. Published by the General Electric Co., Schenectady 5, N. Y. Price, $1.

This bulletin, which was prepared primarily for use in schools, describes the fundamentals of construction and operating principles of all major types of electric instruments, including thermo-couples, frequency meters, telemeters, etc.

TOOL STEP CORRECTION TABLES FOR CIRCULAR FORM TOOLS. By Fred Von Beulwitz. 8 1/2 by 11 inches. Distributed by Industrial Mathematics, Assoc., 4006 N. Hamlin Ave., Chicago 18, Ill. Price, $10.

These tables, which are durably bound in a plastic cover, give corrections for circular form tools designed with top rake, such as are used on Brown & Sharpe automatic screw machines, and flat or dovetail tools used on multiple-spindle automatic screw machines. They give corrections for any basic diameter and for top rake angles ranging from 0 to 30 degrees. The tables cover eighty-four combinations of front and top rake angles.

METALLIC CARTRIDGES. 12 pages, 5 3/4 by 9 1/4 inches. Published by the U. S. Department of Commerce as Simplified Practice Recommendation 62-50 of the National Bureau of Standards. Obtainable from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 5 cents a copy.

WIRE ROPE. 21 pages, 5 3/4 by 9 1/4 inches. Published by the U. S. Department of Commerce as Simplified Practice Recommendation 198-50 of the National Bureau of Standards. Obtainable from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 10 cents a copy.

RESIDUAL STRESSES IN METALS. By Dr. William Marsh Baldwin, Jr., of the Case Institute of Technology. 48 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price, $1.

LIGHTING FOR MACHINING OF SMALL METAL PARTS. 16 pages, 8 1/2 by 11 inches. Published by the Illuminating Engineering Society, 51 Madison Ave., New York 10, N. Y. Price, 50 cents.

MANUAL ON FATIGUE TESTING. 88 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price, $2.50, paper-bound; $3.15, cloth-bound.

* * *

More than 300 engineering graduates will be employed by the Westinghouse Electric Corporation this year. This is approximately 10 per cent more than were added last year.

Obituaries

Trygve D. Yensen

Dr. Trygve D. Yensen, who had just retired as manager of the magnetics department of the Westinghouse Research Laboratories, died on June 30 in Scotland, en route to his native country, Norway. He was sixty-six years old.

Dr. Yensen had spent forty-two years in the science of magnetism, and was world known for his contributions to this basic science. He was a leader in the development of a series of new alloys that have improved the performance of electric motors, generators, and transformers.

Dr. Yensen joined the Westinghouse organization in 1916 as a research engineer in the magnetics department. He centered his attention for the next eight years on the use of carbon in magnetic materials. Later he developed an alloy called "Hipersil" for use in transformers. During the recent war, he collaborated with James K. Stanley, another Westinghouse research engineer, to produce a magnetic alloy named "Hiperco," which may result in the design of lighter weight aircraft motors and generators. Dr. Yensen was the author of more than fifty papers on the subject of magnetism. He is survived by his wife and son.

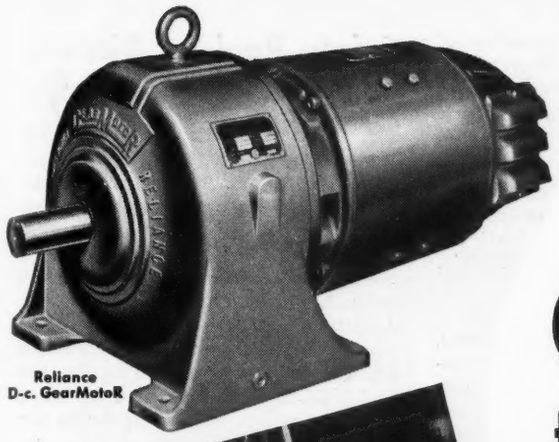
GUSTAV H. ZIMMER, until recently chief engineer of the Machine Tool Division of the Buffalo Forge Co., Buffalo, N. Y., died on June 29 at the Millard Fillmore Hospital in Buffalo, following an illness of several months. He was sixty-eight years old.

A native of Posen, Germany, Mr. Zimmer was educated at Elfeld, Beria, and graduated from the University of Darmstadt in 1904. Coming to Buffalo in 1908, he was employed by the Buffalo Forge Co. in the Engineering Department. Shortly after this, he became chief engineer of the Machine Tool Division of the company, which position he held until illness forced him to retire several months ago.

He was responsible for the design of a line of metal-working equipment, and had an active part in the application of these machines in industry. Mr. Zimmer was for many years a member of the Buffalo Engineering Society.

* * *

Primary aluminum production in May was the highest for any one month since the war's end, according to the Aluminum Association. The figure for May was 123,858,511 pounds, compared with 117,493,525 pounds in April, the previous peak month.



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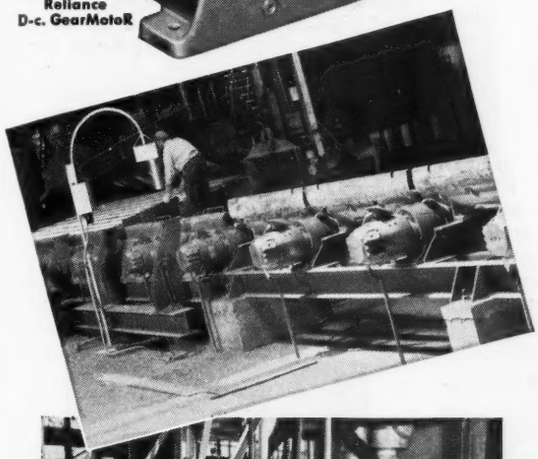
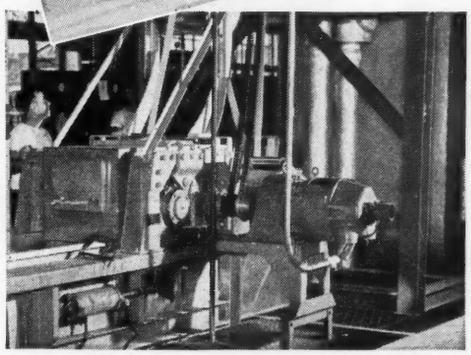
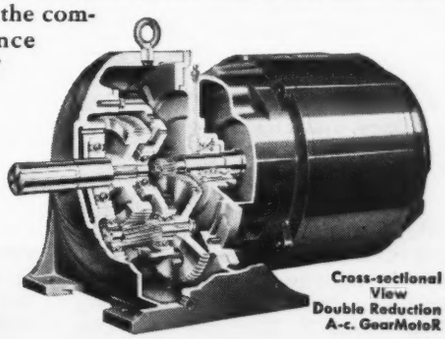
1. Helical, wear-hardened gears cut from alloy steel forgings and shaved before hardening for correct eccentricity and helical angle and bright, smooth surfaces—factors contributing to quiet operation and longer life.
2. Gear arrangement in simple train minimizes number of moving parts—promotes quietness.
3. Pinion and gear supported and spaced to reduce deflection—permits high load-carrying capacity.
4. Splash system with large oil reservoir assures constant and thorough lubrication of all parts.
5. Anti-friction bearing construction throughout.
6. Reliance *Precision-Built* Motors provide the maximum in dependable and economical power.

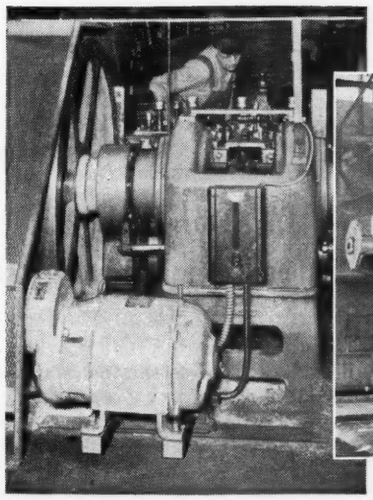


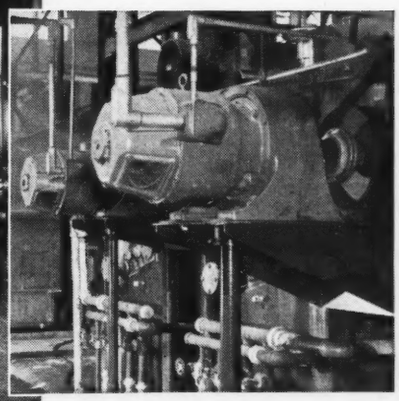


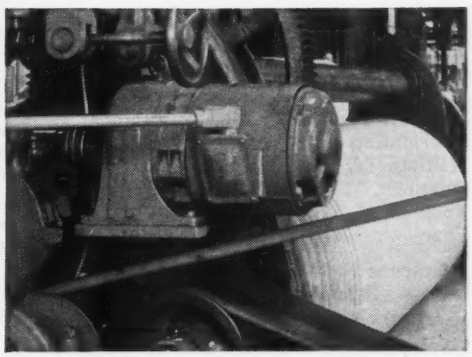
For facts on other proved-in-service advantages of Reliance GearMotoRs, write for Bulletin C-404. Ask at the same time for bulletins describing the complete line of Reliance PRECISION-BUILT Motors.



Cross-sectional
View
Double Reduction
A-c. GearMotoR







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Coming Events

AUGUST 14-16 — NATIONAL WEST COAST MEETING of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Biltmore Hotel, Los Angeles, Calif. Secretary and general manager, John A. C. Warner, 29 W. 39th St., New York 18, N. Y.

SEPTEMBER 13-18—Twenty-seventh annual convention of the NATIONAL ASSOCIATION OF FOREMEN at the Hotel Statler in Buffalo, N. Y. Further information can be obtained by addressing the Association at its headquarters, 321 W. First St., Dayton 2, Ohio.

SEPTEMBER 18-22—FIFTH NATIONAL INSTRUMENT EXHIBIT of the INSTRUMENT SOCIETY OF AMERICA in the Memorial Auditorium, Buffalo, N. Y. Further information can be obtained from the Society at 921 Ridge Ave., Pittsburgh 12, Pa.

SEPTEMBER 25-27 — Sixth annual NATIONAL ELECTRONICS CONFERENCE EXHIBITION at the Edgewater Beach Hotel, Chicago, Ill. Chairman of exhibit committee, Kipling Adams, 920 S. Michigan Ave., Chicago 5, Ill.

SEPTEMBER 26-29—IRON AND STEEL EXPOSITION, in conjunction with the annual convention of the ASSOCIATION OF IRON AND STEEL ENGINEERS, at the Cleveland Public Auditorium, Cleveland, Ohio. For further information, address the Association, 1010 Empire Bldg., Pittsburgh 22, Pa.

OCTOBER 16-20 — Thirty-eighth NATIONAL SAFETY CONGRESS and EXPOSITION in Chicago, Ill. R. L. Forney, general secretary, National Safety Council, 425 N. Michigan Ave., Chicago, Ill.

OCTOBER 18-20 — Annual national conference of the SOCIETY OF THE PLASTICS INDUSTRY, at New Ocean House, Swampscott, Mass. Further information can be obtained from William T. Cruse, executive vice-president, 295 Madison Ave., New York 17, N. Y.

OCTOBER 23-27—Fall meeting of the Metals Branch of the AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS in Chicago, Ill. National secretary, E. H. Robie, 29 W. 39th St., New York 18, N. Y.

OCTOBER 23-27—Annual meeting of the AMERICAN SOCIETY FOR METALS in Chicago, Ill. National secretary, W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.

OCTOBER 23-27—Annual meeting of the AMERICAN WELDING SOCIETY in Chicago, Ill. National secretary, J. G. Magrath, 33 W. 39th St., New York 18, N. Y.

OCTOBER 23-27—Annual meeting of the SOCIETY FOR NON-DESTRUCTIVE TESTING in Chicago, Ill. National secretary, Philip D. Johnson, Skokie, Ill.

OCTOBER 23-27 — NATIONAL METAL CONGRESS and EXPOSITION at the International Amphitheater, Chicago, Ill. For further information, address W. H. Eisenman, managing director, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

NOVEMBER 2-3—Fourteenth annual NATIONAL TIME, MOTION, AND MANAGEMENT CLINIC at the Sheraton Hotel, 505 N. Michigan Ave., Chicago, Ill. Sponsored by the Research Division of the Industrial Management Society, 35 E. Wacker Drive, Chicago 1, Ill.

NOVEMBER 27-DECEMBER 2 — NINETEENTH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING at the Grand Central Palace, New York 17, N. Y., in conjunction with the annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary of A.S.M.E., Clarence E. Davies, 29 W. 39th St., New York 18.

* * *

Winner of Ohio Crankshaft Co.'s "Economy in Production" Contest

John Nelson, a young engineer with Commercial Shearing and Stamping, Youngstown, Ohio, was awarded the first prize of $1000 in the "Economy In Production" contest sponsored by the Ohio Crankshaft Co., Cleveland, Ohio. The prize-winning idea involved the use of Tocco induction heating equipment for brazing hydraulic cylinders used on farm and construction machinery. The application more than doubled production and reduced costs 50 per cent.

The other winners were L. F. Groves, works metallurgist at the Allis Chalmers Mfg. Co., Laporte, Ind., who received $500 as second prize, and George S. Bidigare and R. E. Van Deventer, metallurgists with the Packard Motor Co., Detroit, Mich., who were jointly awarded the third prize of $250.

* * *

Spun from stainless steel, the cone of the newest type glass-and-metal television tube costs less than the conventional all-glass tube, and has helped to reduce the price of television sets.

Safety Reel for Dispensing Band-Saw Stock

A safety reel dispenser of band-saw coil stock has been made available by the L. S. Starrett Co., Athol, Mass. This new reel dispenser holds a 100-foot coil secure by a revolving arm which keeps the coil stock safely in place at all times and, when rotated, releases any desired length. A cut-out on the side of the reel shows instantly the approximate amount of stock remaining in the reel. Each reel is labeled to show the type, width, gage, and depth per inch of contents.

Among the advantages claimed for this device are safe handling in storage of band-saw stock; easy selection of any desired length; immediate identification of contents and amount on hand; and complete protection from rust and dirt.

Reel dispenser developed to facilitate storing and handling of band-saw stock

On the back of the reel container are printed recommendations for selecting the right type and size of band and cutting speed for most metals and other materials.

* * *

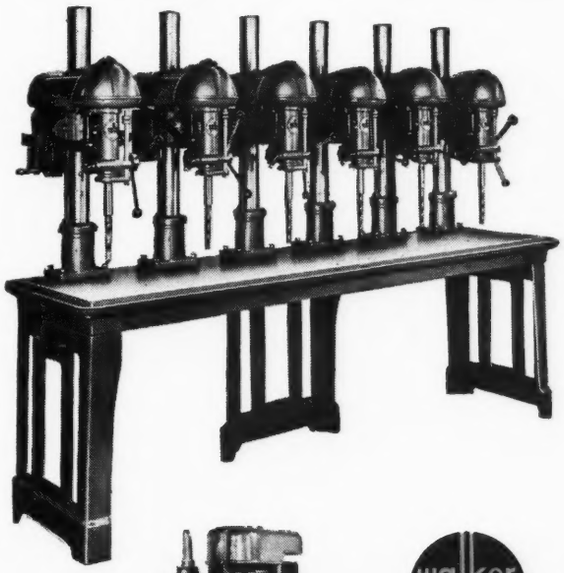
Plug and Ring Thread Gage Slide-Rule

A slide calculator that provides a rapid means of obtaining standard thread plug and ring gage dimensions for the new Unified and American screw threads has been made available by the Taft-Peirce Mfg. Co., Woonsocket, R. I. A single setting determines major diameter and pitch diameter of "Go" and "Not Go" thread plug gages for Classes 1B, 2B, and 3B, and minor diameter and pitch diameter of "Go" and "Not Go" thread ring gages for Classes 1A, 2A, and 3A. Further information, including price, can be obtained from the company.

Cut your production costs

WALKER-TURNER *designed* DRILL PRESSES

cover a wide range of models, speeds, service



20″ DRILL PRESS 6 Spindle, Hand Feed

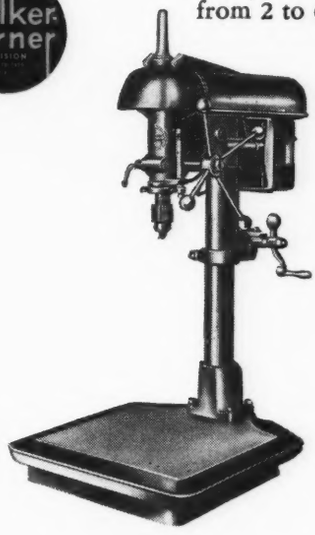
5 Speeds: 400, 800, 1200, 1800, 2600 (using a 1740 r.p.m. motor).
Spindle Travel: 6″.
Capacity: 1″.
Head Construction: one-piece gray iron casting, line-bored for greater accuracy.
For the industrial user where the production rate and initial cost are primary factors. Particularly effective in increasing production on many jobs where a series of holes are to be drilled, tapped, reamed or counterbored in a single piece. Other multiple-spindle models from 2 to 6 spindles.

RADIAL DRILL PRESS

15 Spindle Speeds: 110-5400 r.p.m. (using an 1140 r.p.m. motor) 160-8300 r.p.m. (using a 1740 r.p.m. motor).
Ball bearing thrust collar carries head and ram assembly —drill can be tilted in either direction, to any angle up to 45°. Drill head, ram and cradle may be swung in a complete circle around the column.

A quick-action lock secures drill in any position, and assures minimum amount of deflection.

The Walker-Turner Radial Drill Press handles all drilling and tapping jobs up to ½″ in cast iron with the efficiency of a larger machine where capacity may be wasted on the small job. Particularly valuable wherever large, cumbersome or heavy pieces of work make it easier to move the drill head rather than the work.



15″ PRODUCTION MODEL

4 Speeds: 600, 1250, 2440, 5000 r.p.m.

Spindle Travel: 4¼″.

Capacity: 18½″ chuck to table.

Head Construction: one-piece gray iron casting, line-bored for greater accuracy.

Compact, portable: can be located in assembly lines, reducing handling costs.

Adaptable for sanding, grinding, mortising, shaping and many other metal and woodworking operations. Bench and floor models.

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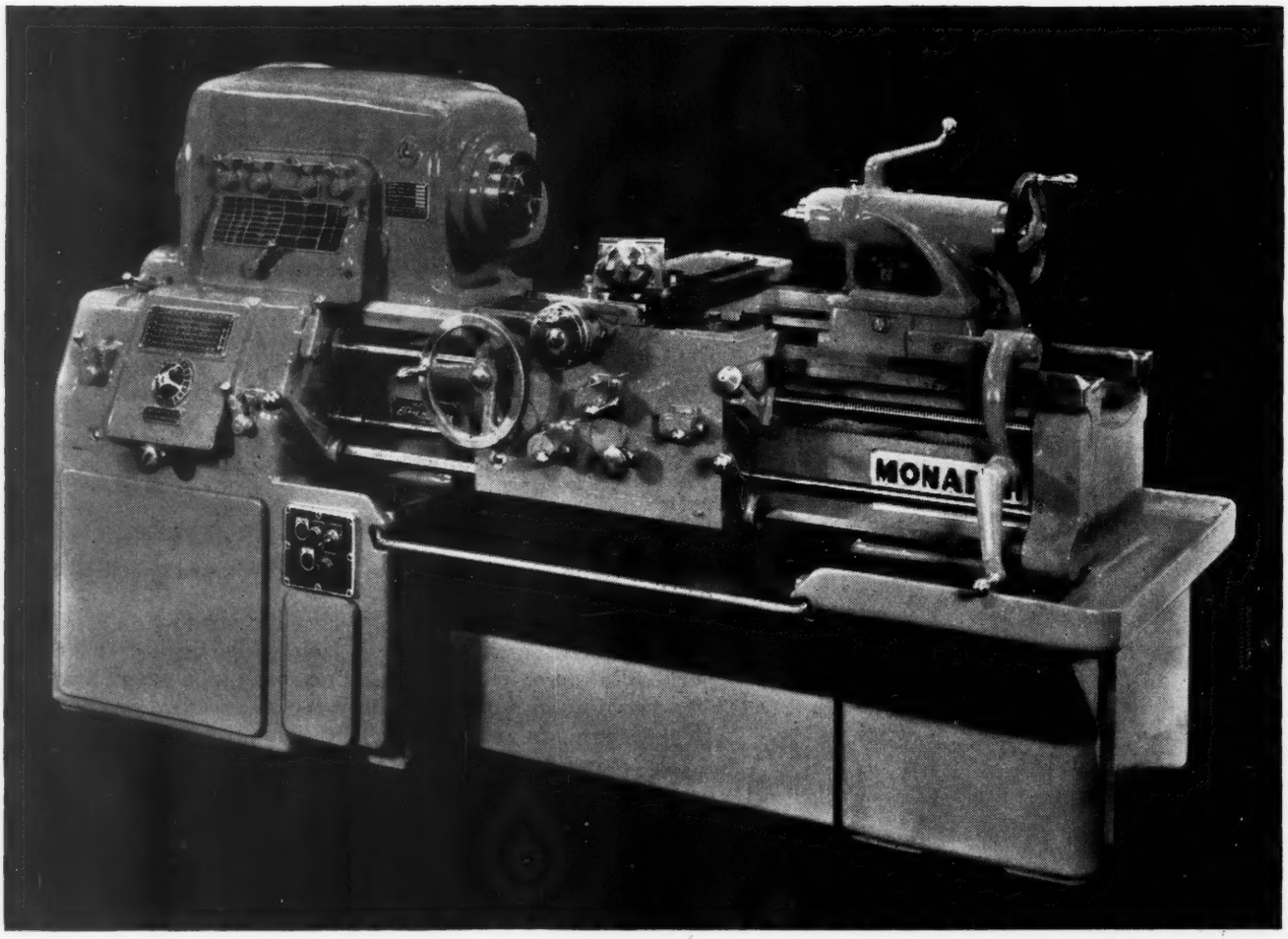

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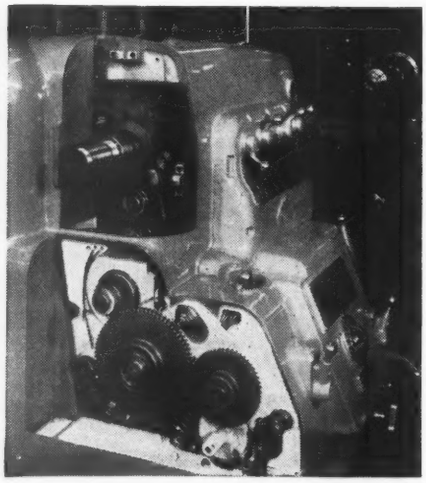
. . . with longer life, at sustained original accuracy, preserved by totally-enclosed gearbox and end gearing. This Monarch design "plus" permits the use of automatic pressure lubrication to both. The result is years of attention-free operation, with factory-fresh precision and efficiency.

Total enclosure of these vital parts reduces normal servicing requirements to a minimum, and equally important, prevents accidental introduction of foreign matter of all kinds.



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Only the Monarch Series 60 engine and toolmakers' lathes have this exclusive combination of enclosed gearing—and this is just *one* of many design and construction features that mean more savings with Monarch's Series 60 Machines —available in 14", 16" and 20" sizes. You'll save on operation, you'll save on maintenance. Like more facts? Ask for Booklet 1113.

You'll Save on Maintenance and Operating Expense With These Series 60 Features:

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2. Automatic pressure lubrication—insures long life at original efficiency.

3. All anti-friction bearings — for peak power and less maintenance.

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5. American Standard Camlock spindle Nose—for quick, rigid chuck and fixture mounting.

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three parts automatically to complete

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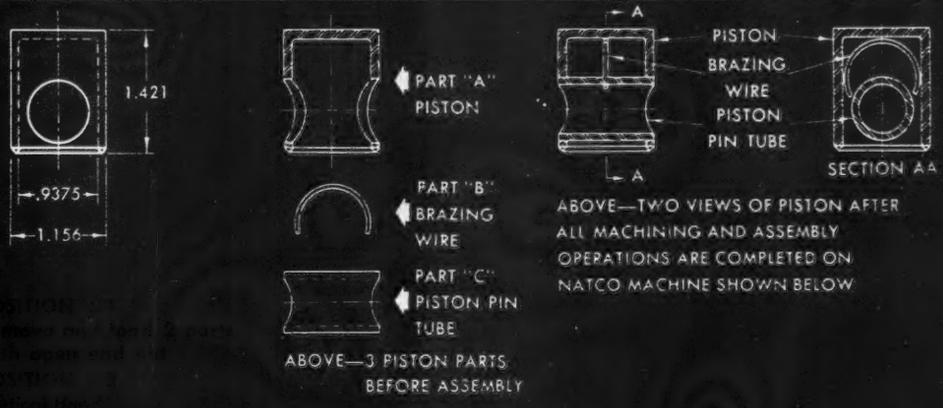
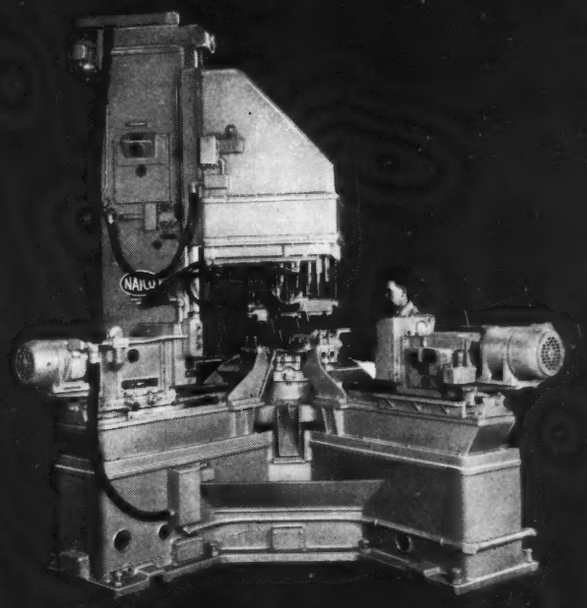


ABOVE—3 PISTON PARTS BEFORE ASSEMBLY

ABOVE—TWO VIEWS OF PISTON AFTER ALL MACHINING AND ASSEMBLY OPERATIONS ARE COMPLETED ON NATCO MACHINE SHOWN BELOW



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This NATCO four-way vertical and horizontal drilling machine is just one of the many examples of the way NATCO contributes to higher production and lowered costs for industry. Send us your drilling, boring, tapping or facing problems . . . our engineers have the solution.

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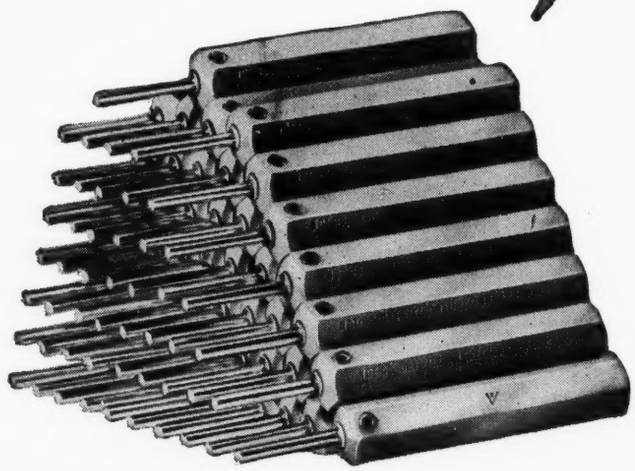
Van Keuren

CARBOLOY
Wire Type
PLUG GAGES
are the right answer



1 VK CARBOLOY=50 TOOLSTEEL GAGES

After considerable experimentation with various wear resistant materials, we have chosen Carboloy as being the most practical, durable and economical. Carboloy does not flake or chip easily and is quite suitable for wire type plug gages as small as .020" in diameter.

Wire Type Plug Gages were originated by the Van Keuren Co. in 1925 and are now recognized as the most economical gages for measuring small holes. The original wire type plug gages were made of tool steel—High Speed steel doubled gage life. VK Chromium Plate gave 5 times the life, and VK Carboloy 50 times the life of tool steel gaging units. All of these materials are still in use and have their particular applications.

VK Carboloy gaging units are made in sizes from .020" to .500" diameter. They are made only in the wire type design because this is by far the most economical plug gage. In cases where it is desired to use VK Carboloy wire type Go units with existing No Go taper insert units, special handles can be furnished for this purpose.

Van Keuren Wire Type Plug Gages assure longer lasting precision and lower gage cost, because the entire 2" length of gage can be used. When the end of the wire becomes worn, it is ground off. The wire type unit is securely held in the unit by a split bushing and a headless set screw.

VK Carboloy Wire Type Plug Gages are made to Class B accuracy, plus .00005" minus, .00000" on the Go unit and plus or minus .000025" on the No Go unit. Closer or wider tolerances can be supplied if desired.

On your next order Specify VK Wire Type Plug Gages: VK Carboloy for long runs because of the enormous saving in gage cost; VK Carboloy for fussy jobs because of the infinitesimal gage wear and insurance that the parts will be within the specified limits; VK Tool Steel—High Speed Steel—Precision Chromium for less exacting jobs. You will be assured of the best in accuracy, quality and delivery.

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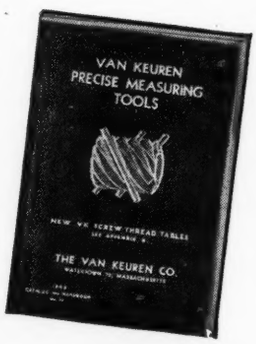
This 208 page volume represents 2 years of research sponsored by the Van Keuren Co.

It presents for the first time in history a simple and exact method of measuring screws and worms with wires.

It tells how to measure gears, splines and involute serrations. It is an accepted reference book for measuring problems and methods.

Copies are free upon request.



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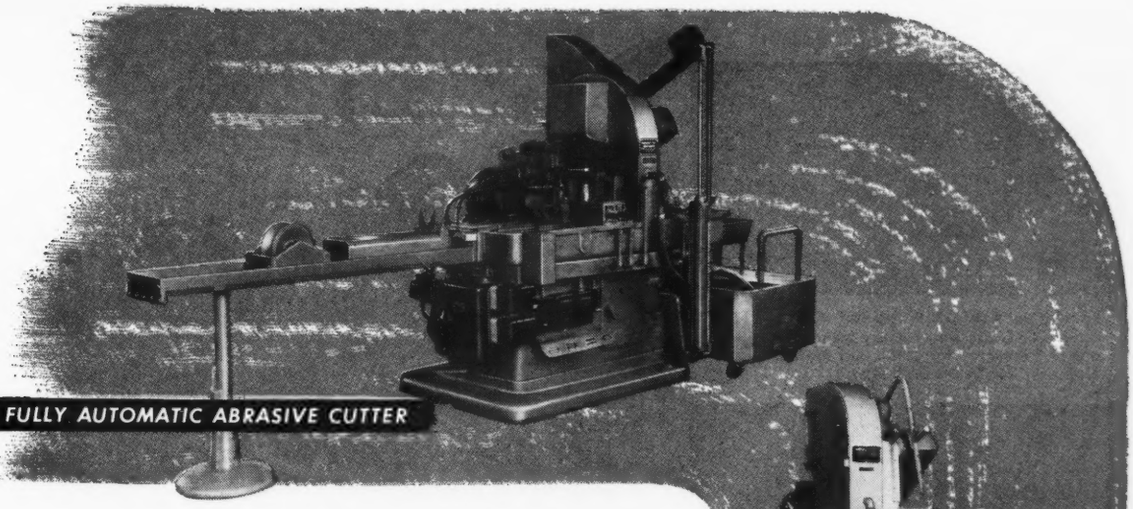

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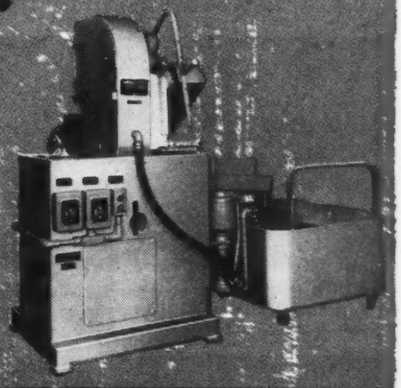
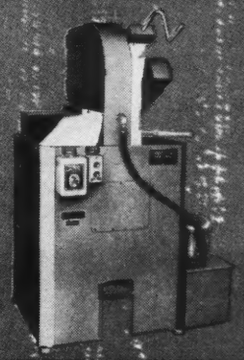
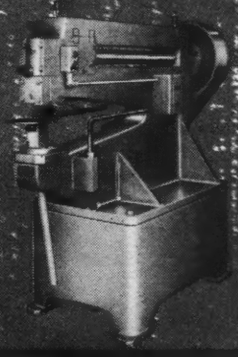
CUTTING AND NIBBLING MACHINES



MODEL 223 ABRASIVE CUTTER



MODEL 15 ABRASIVE CUTTER



MODEL 530 NIBBLING MACHINE

ABRASIVE CUTTING Annealed or unannealed steel of any analysis, brass, bronze, monel, ceramics, phenol plastics, glass, tungsten, tantalum carbide—these and many other materials can be cut abrasively, in many cases cheaper and better than by any other method.

NIBBLING The efficient way to cut irregular shapes out of sheet steel (up to ½" mild steel, 5/16" stainless) where quantities do not justify making a special die. CAMPBELL offers a wide range of models for tool rooms, machine shops, experimental departments, sheet metal departments, production lines. Multiple speed and adjustable stroke provided.

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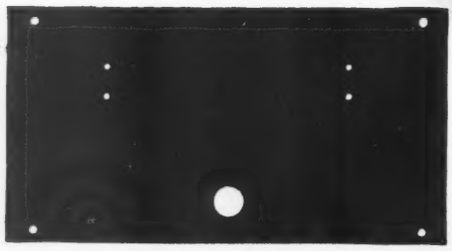
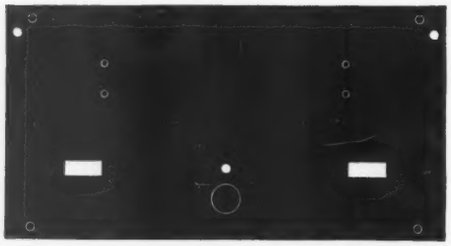
925 Connecticut Ave., Bridgeport 2, Conn.

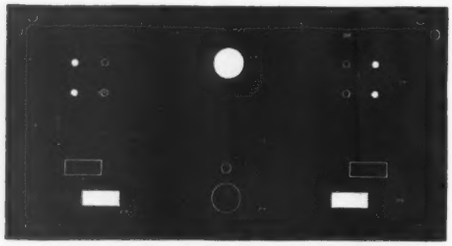
CAMPBELL Abrasive Cutters and Nibbling Machines



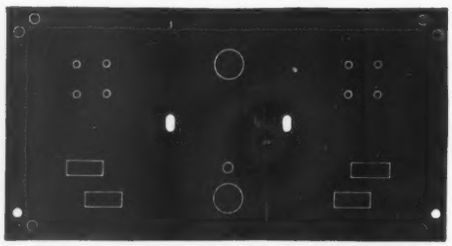
Setting up 3 Work Stops and 9 Wales Hole Punching Units for above operation required only 9.6 minutes. See combined set-up and running time for 50 pieces below.



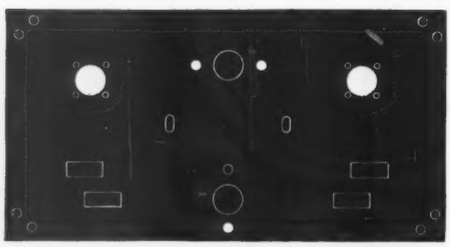
Setting up 2 Pick-up Stops and 5 Wales Hole Punching Units for above operation required only 6 minutes.



Setting up 2 Pick-up Stops and 7 Wales Hole Punching Units for above operation required only 7.6 minutes.



Setting up 2 Pick-up Stops and 4 Wales Hole Punching Units for above operation required only 5.2 minutes.



Setting up 2 Pick-up Stops and 5 Wales Hole Punching Units for above operation required only 6 minutes.

PERFORATING TIME AVERAGES APPROXIMATELY .2 MINUTES PER OPERATION, THE TOTAL RUNNING TIME FOR 50 PIECES IS (.2 x 50 x 5 OPERATIONS) 50 MINUTES.

THE COMBINED SETUP AND RUNNING TIME OF THE 50 PIECES IS 34.4 PLUS 50 OR A TOTAL OF 84.4 MINUTES.

COMPARE

WALES

TIME STUDIES

WITH YOUR PRESENT METHODS

● If your present methods of hole punching do not produce similar parts including set-up time as fast as the total time of the typical part shown at the left you are letting dollars fly out your window.

The patented design features of Wales Type "BL" Hole Punching Units provide *cost savings* that you cannot afford to overlook. For example, only 16 Wales Type "BL" Hole Punching Units were required to punch the 30 holes in the work shown at left.

Write for fully-illustrated Bulletin 7 TODAY and have all the cost-saving facts at your finger tips.

WALES-STRIPPIT CORPORATION

GEORGE F. WALES, *Chairman*

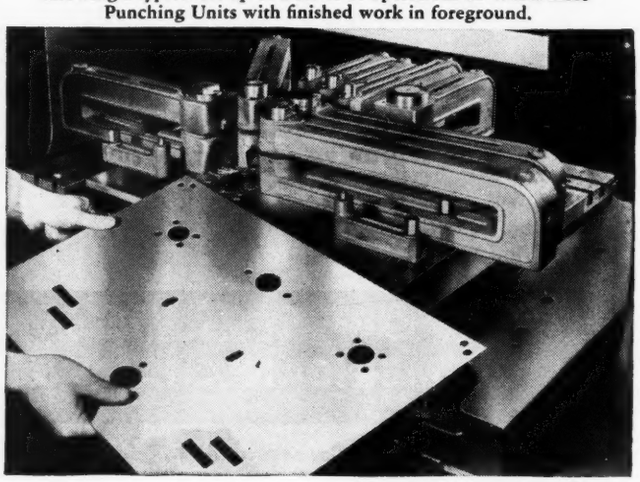
375 PAYNE AVENUE, NORTH TONAWANDA, N. Y.

(Between Buffalo and Niagara Falls)

WALES-STRIPPIT OF CANADA, LTD., HAMILTON, ONTARIO

Specialists in Punching and Notching Equipment

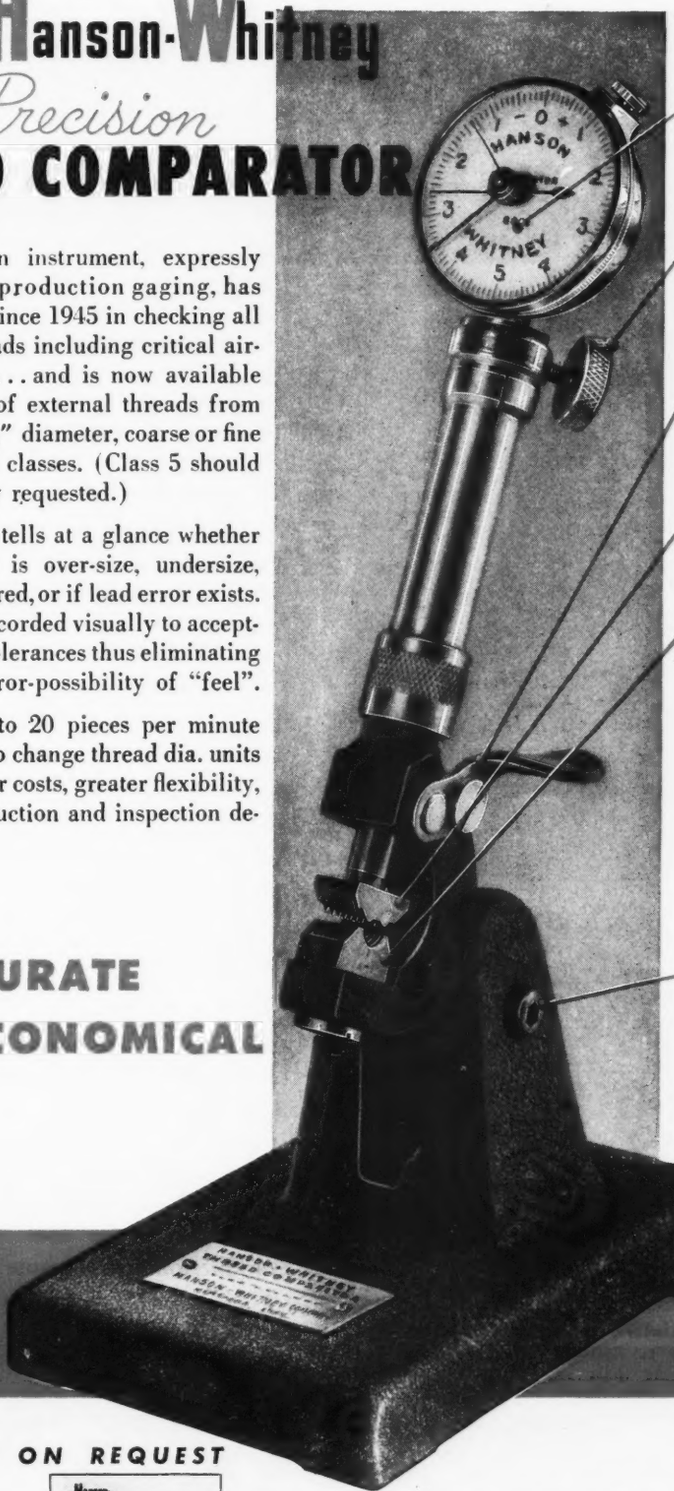
Showing a typical set-up of a series of operations of Wales Hole Punching Units with finished work in foreground.



For more information on products advertised, use Inquiry Card, Page 225

Check Thread Accuracy... VISUALLY

WITH Hanson-Whitney *Precision* THREAD COMPARATOR



This precision instrument, expressly designed for production gaging, has proven itself since 1945 in checking all forms of threads including critical aircraft threads . . . and is now available to producers of external threads from 0 through 3⅛" diameter, coarse or fine pitches, in all classes. (Class 5 should be specifically requested.)

The indicator tells at a glance whether your product is over-size, undersize, eccentric, tapered, or if lead error exists. The work is recorded visually to accepted ring gage tolerances thus eliminating the human error-possibility of "feel".

Checking up to 20 pieces per minute . . . 3 minutes to change thread dia. units . . . means lower costs, greater flexibility, for both production and inspection departments.

FAST
ACCURATE
ECONOMICAL

1. Indicator is equipped with tolerance hands and is graduated in tenths of thousands. Any type indicator with ⅜" shank may be used.

2. Comparator easily set to desired reading by loosening knob and lowering indicator. Tighten knob screw to lock indicator in correct position.

3. Lever controls positioning of upper anvil. Can be easily raised or lowered to insert or remove work. This action eliminates excessive wear on anvils.

4. Comparator is easily set – insert setting plug, lower upper anvil. Set indicator at tolerance required.

5. Thread anvils are actually a split internal thread member to check assemble-ability and to give exact reading on indicator dial of part checked within .0002 accuracy. Anvil core hardened to 60-62 "C". Standard unit will check any P.D. from class 1 to 4 and only one set plug (of known P.D.) is required for all classes.

Standard recognized 2½ lb. pressure is maintained on work to hold it in reading position, eliminating human element while taking reading.

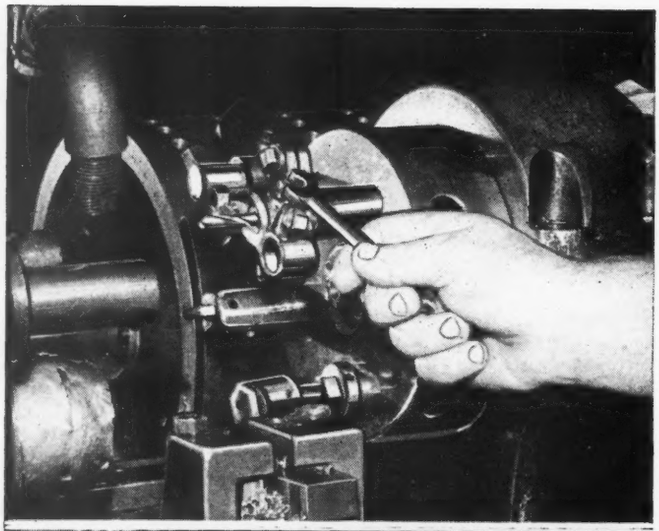
6. Complete gaging unit may be removed by loosening screw for change in size setting. Can also be used after removal for checking parts on machine. Complete removal and resetting accomplished in less than three minutes.

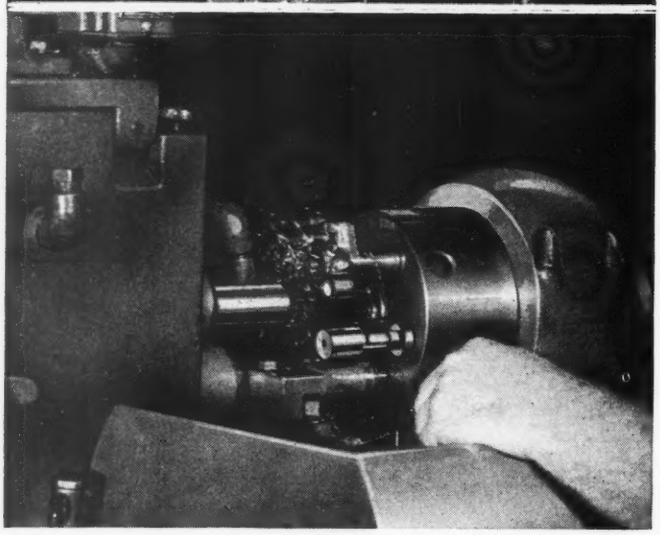
BULLETIN ON REQUEST

HANSON-WHITNEY COMPANY, HARTFORD 2, CONN.
DIVISION OF WHITNEY CHAIN COMPANY

Bulletin shows detailed various parts of the H-W Comparator (all available separately). Send for your copy today.

SHW50





FAST ON THE SET-UP

The fast set-up feature of R and L Turning Tools is used to good advantage by The Glenn L. Martin Company of Baltimore, in the production of small aircraft bushings and studs. R and L Turning Tools are easy—and practical—to use for comparatively short runs, because they can be speedily set up to perform combinations of two or three jobs at one work station, and quickly changed from right- to left-hand operation.

FAST ON THE JOB!

R and L Turning Tools give you an immediate increase in output by enabling you to perform simultaneously combinations of operations such as drilling, turning and burnishing; turning and centering; form turning; turning two diameters; facing and reaming and many other jobs. Built in five sizes to cover a wide range of screw machine and turret lathe jobs, R and L Turning Tools are constructed of heat-treated alloy steel, with all essential parts ground to insure accurate alignment. The other tools in the R and L line have similar advantages that will help you get increased production capacity from your machines on threading and turning jobs. Write for your copy of the idea-packed R and L Booklet that shows how these versatile tools can lower tool costs and boost production at the same time. R and L Tools, 1825 Bristol Street, Nicetown, Philadelphia 40, Pa.

NEW!

R and L Turret Backrest Holders

Simple design allows for convenient interchanging of the R and L carbide surfaced backrest or Roller Backrest. Built in three sizes: ⅝", ¾" and 1" diameter shank.

RIGHT AND LEFT R L TOOLS

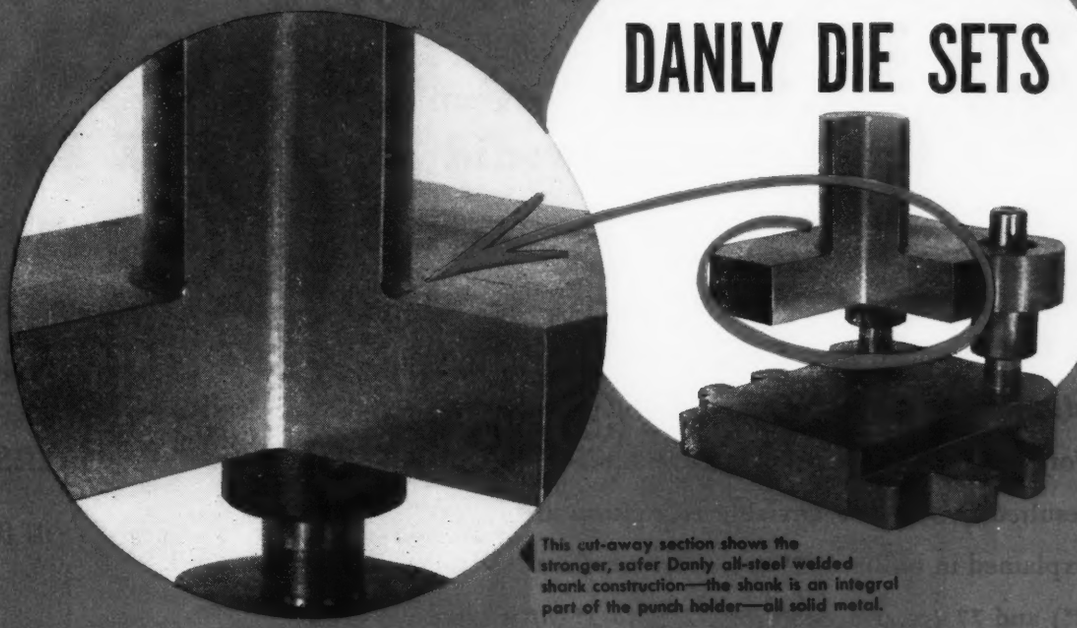
TURNING TOOL—UNIVERSAL TOOL POST—FLOATING DRILL HOLDER—CARBIDE AND ROLLER BACKRESTS—REVOLVING STOCK STOP

TAP AND DIE HOLDER—CUT-OFF BLADE HOLDER—TURRET BACKREST HOLDER—RELEASING ACORN DIE HOLDER—KNURLING TOOL

For more information on products advertised, use Inquiry Card, Page 225

This quality feature is STANDARD construction on all-steel shank type

DANLY DIE SETS



This cut-away section shows the stronger, safer Danly all-steel welded shank construction—the shank is an integral part of the punch holder—all solid metal.

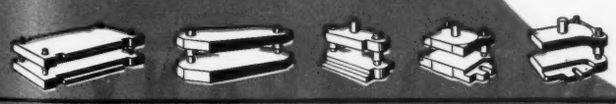
DANLY INTEGRAL WELDED SHANK

A new welding technique that assures 100% fusion of shank to punch holder makes this superior construction possible. Knock out holes in the shank itself or machining on the punch holder face are much less likely to effect shank strength.

Features like this make Danly the nation's leading die set producer. Check these other Danly Die Set advantages and you'll see why die makers and production men everywhere prefer Danly Die Sets:

- *prompt delivery* . . . from the nearest of the nation wide system of Danly assembly branches.
- *precision construction* . . . leader pins and bushings hardened and ground to precision tolerances and lapped after assembly to provide a smooth running fit.
- *broad selection* . . . the wide range of Danly standard and stocked special die sets meets nearly every tooling need.
- *Danly reliability* . . . every Danly Die Set is backed by the experience accumulated in more than a quarter century of service to the stamping industry.

DANLY MACHINE SPECIALTIES, INC.
2100 South Laramie Avenue, Chicago 50, Illinois



PRECISION DIE SETS . . . STANDARD AND SPECIAL

WHICH DANLY BRANCH IS CLOSEST TO YOU?

Danly Branch Offices: *Chicago 50, 2100 Laramie Avenue • *Cleveland 14, 1550 East 33rd Street • *Dayton 2, 990 East Monument Avenue • *Detroit 16, 1349 Temple Avenue • *Grand Rapids, 113 Michigan Street, N.W. • *Long Island City 1, 47-28 37th Street • *Los Angeles 54, Ducommun Metals & Supply Co., 4890 South Alameda • Milwaukee 2, 111 East Wisconsin Avenue • Philadelphia 44, 18 West Chelten Avenue • *Rochester 4, 16 Commercial St.
*Indicates complete stock

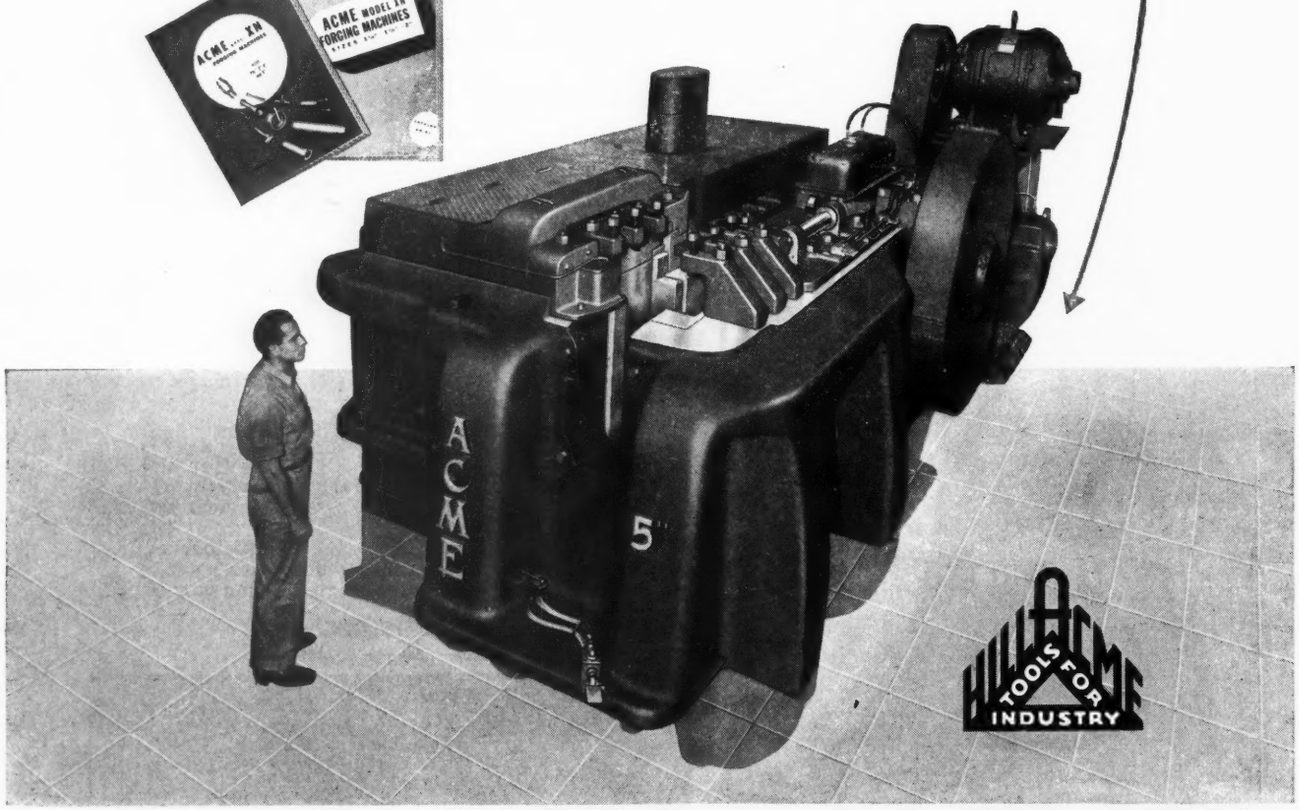
DANLY®

5 Reasons

why YOUR next Forging machine should be an ACME XN

• Any ONE of these exclusive features would make an ACME XN Forging Machine a good investment. Added together they assure you of a faster operating, more accurate and longer lived Forging Machine. All the other features that have resulted in ACME's enviable reputation are fully explained in bulletins 57 (*covering sizes from 1½" to 2"*) and 77 (*covering sizes from 2½" to 5" capacity*).

- HEAVIER CONSTRUCTION
- ECCENTRIC TYPE MAINSHAFT
- EXTRA LONG HEADER SLIDE
- NITRALLOY LINERS
- VENTILATED CUSHION DRIVE

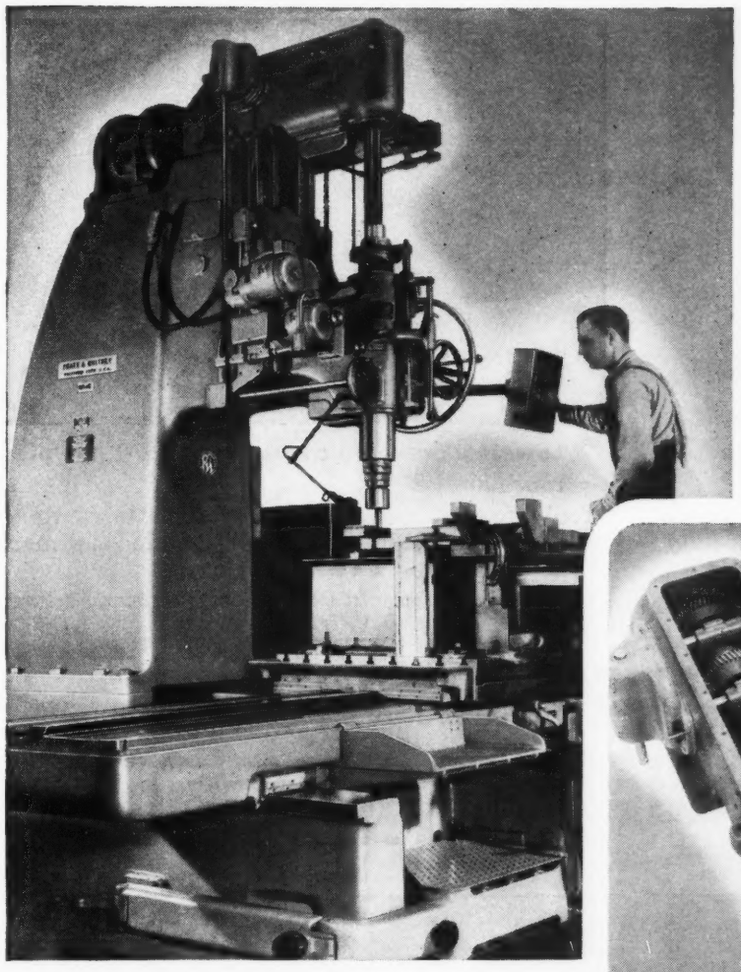


THE HILL ACME COMPANY

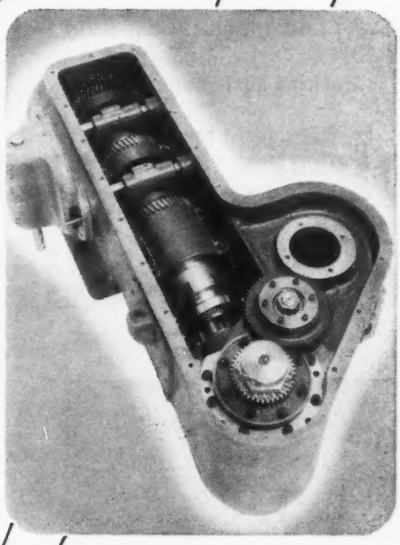
ACME MACHINERY DIVISION • **1201 W. 65th St., Cleveland 2, Ohio**
ESTABLISHED 1882

"ACME" FORGING • THREADING • TAPPING MACHINES • ALSO MANUFACTURERS OF "HILL" GRINDING AND POLISHING MACHINES
HYDRAULIC SURFACE GRINDERS • "CANTON" ALLIGATOR SHEARS • PORTABLE FLOOR CRANES • "CLEVELAND" KNIVES • SHEAR BLADES

For more information on products advertised, use Inquiry Card, Page 225



15 TONS OF *Accuracy!*



Pratt & Whitney Model 4E Jig Borer.

Inset: View of Twin Disc MTU Duplex Clutch in the gearhead.

. . . with a Twin Disc Clutch

It takes real *precision* to locate and bore holes with an accuracy of *.0002"*. But Pratt & Whitney's new Model 4E Jig Borer does it. A 15-ton example of accuracy, stability and fine workmanship, this machine utilizes a 4½" Twin Disc MTU Duplex Clutch and brake combination in the gearhead.

Built to "wear like a bearing and perform like the best friction clutch" . . . that's the standard to which Twin Disc machine tool clutches are held. In addition to compactness, high torque capacity and long wear-life, Twin Disc Clutches feature ease of operation and single point adjustment. No wonder precision manufacturers like Pratt & Whitney think of Twin Disc when their design calls for *accuracy.*

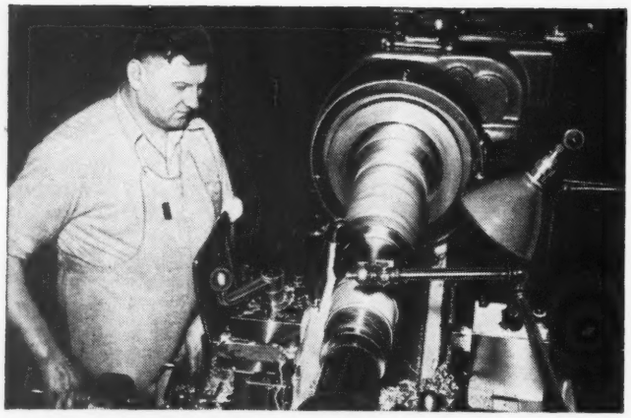
For more information on Twin Disc Machine Tool Clutches see your nearest Twin Disc dealer or write for Bulletin No. 134-A.

TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES

Clutches & Hydraulic Drives

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin • HYDRAULIC DIVISION, Rockford, Illinois

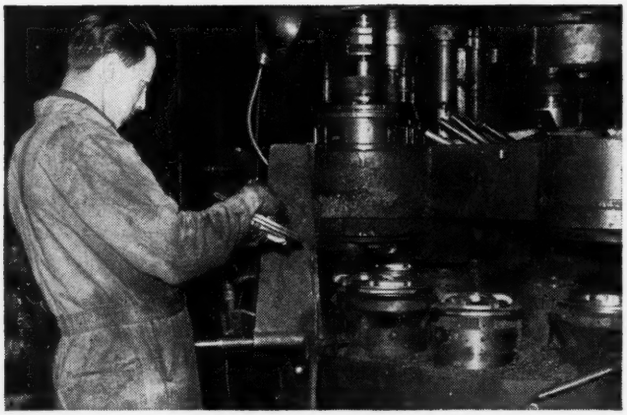
BRANCHES: CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEWARK • NEW ORLEANS • SEATTLE • TULSA



1 Lowest *plant-wide* average machining cost per piece machined

"In 1500 jobs tooled with Carboloy, machining costs dropped an average of 25%, and machine capacity increased an average of 43%."

*Machine tool manufacturer**

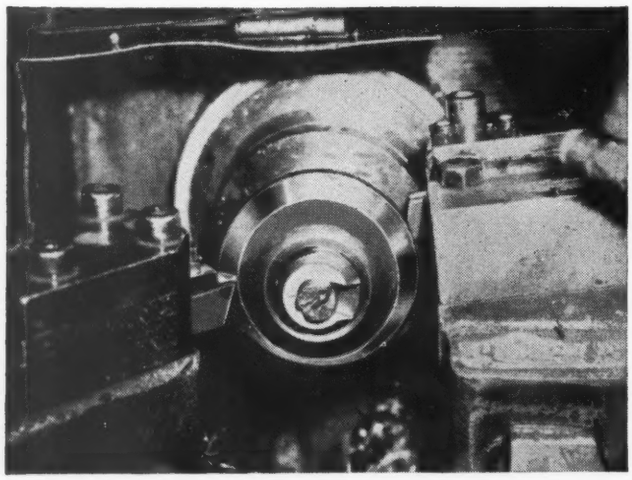


2 Lowest *plant-wide* average tool cost per piece machined

"Tool life has been increased from 6 to 50 times, with piece production almost doubled in many cases."

*Eastern washing machine manufacturer**

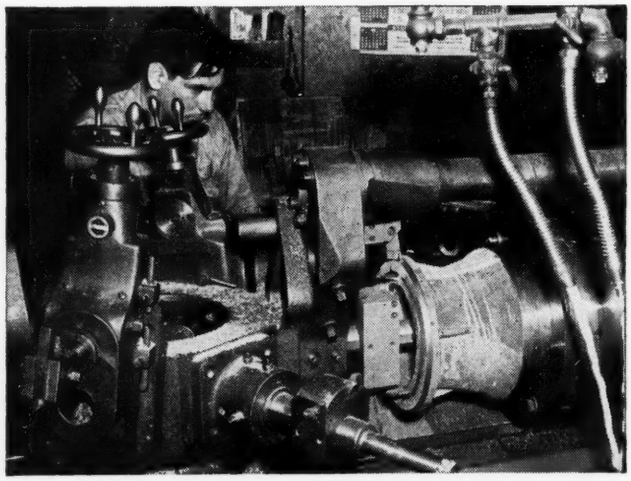
Carboloy, because it's uniform, pays off like this . . . plant-wide



3 Highest *plant-wide* average production per machine

"With fewer machine tools in operation, production was more than doubled, but cost per piece was not increased . . . despite material cost gains."

*Midwest manufacturer**



4 Close *plant-wide* production control standards to which you can absolutely adhere

"Our tool and methods engineers have used predetermined time standards, but have found greatest benefits are possible only with long life and repeated uniform performance of carbide tools."

*Large manufacturer of pumps**

Write today for further information

CARBOLOY COMPANY, INC. 11147 E. 8 Mile Street, Detroit 32, Michigan

*Name on request

CARBOLOY® CEMENTED CARBIDE **IT'S UNIFORM ✓**

✓ . . . in every tool ✓ . . . in every order ✓ . . . in every re-grind

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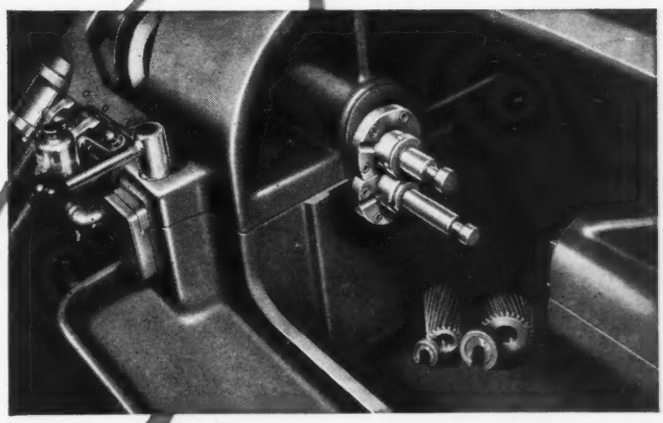
quick test screens out noisy transmission gears **before assembly**



A quick test on this new Red Ring Gear Sound Tester, equipped for air clamping, tells you immediately whether or not you have any noisy gears which will need additional processing before they are assembled into automatic transmissions.

The gear being tested is slipped onto the upper arbor and its pinion onto the arbor below, with a C-washer following each. Touching the air control lever locks both in place for the sound test which is run forward and reverse at various speeds and loading. Both gear and pinion are demounted just as easily after the test.

The gears are clamped by a predetermined spring pressure for positive safety under test. The compressed air is used to release the spring pressure for quick loading and unloading.

WRITE FOR SPECIFIC DATA AND PRICES.

5601

NATIONAL BROACH AND MACHINE CO.

5600 ST. JEAN . . . . . DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

ARMSTRONG

Use the Correct . . .

ARMSTRONG TOOL HOLDERS

to increase pieces, production and profits!

Because they do their work so well, without repairs, maintenance or replacement . . . because they last for years and have become as much a part of everyday operations as steel itself, the importance of using the correct type and size ARMSTRONG TOOL HOLDER for each operation, is frequently overlooked. It should always be remembered that by controlling the cutting point, ARMSTRONG TOOLS control both the productivity and efficiency of every lathe, planer, slotter, and shaper in most shops.

Tools so vitally situated, no matter how trouble-free, deserve periodic checking . . . checking to see that the correct size and correct type ARMSTRONG TOOL HOLDER is being used for each operation: checking to be sure that you are taking full advantage of the newer additions to the Armstrong System—the special types for ARMIDE (Carbide Tipped) Cutters, others for ARMALLOY (Cast Alloy) Bits and Blades; the newer "spring" form threading tools and cutting-off, etc., etc.

Write for a recent ARMSTRONG Catalog and check your tooling of each operation.

ARMSTRONG BROS. TOOL CO.

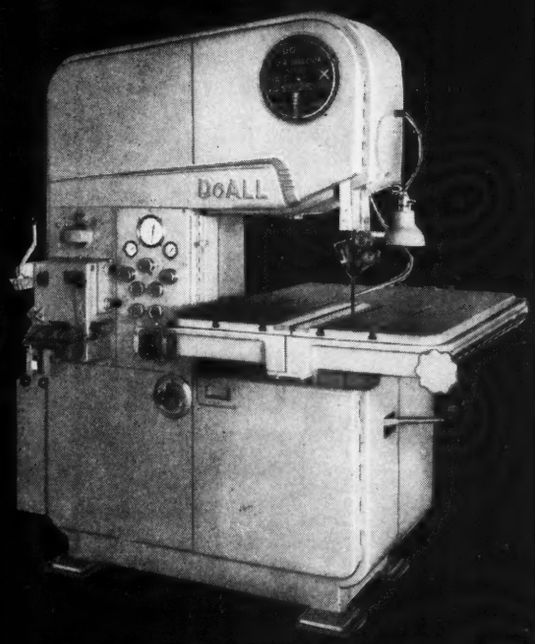
"The Tool Holder People"

5213 WEST ARMSTRONG AVENUE • CHICAGO 30, ILLINOIS

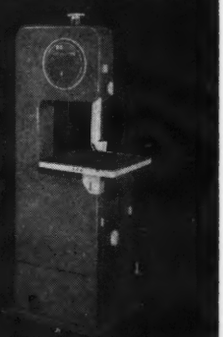
For more information on products advertised, use Inquiry Card, Page 225

Efficiency of . . .
Continuous BAND CUTTING
Now Extended to the MACHINING of ALL SOLID MATERIALS

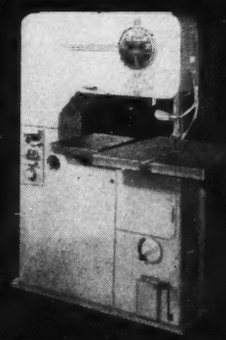
New DoALL Band Machines and Cutting Tools for 1950 give up to 200% faster production cutting and up to 100% longer tool life. Tough alloys and other materials that have defied economical cutting are now profitably machined.



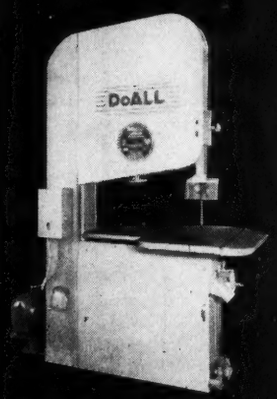
Contour-matic—the first Band Machine Tool with Complete Hydraulic operation.



Low-Cost Utility DoALLs, 5 models, various speeds, 16" capacity.



Contour Machines—5 models from 16" to 60" capacity.



Super Zephyr—21 models for high speed sawing.

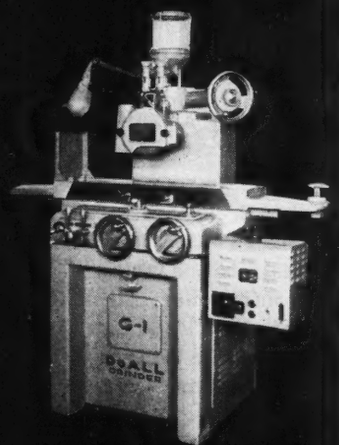
SEE DEMONSTRATIONS AT DoALL STORES

These latest Tool Room and Manufacturing Tools will be in operation on materials demonstrating:

Line Milling	**"Cool Grinding"**
Line Grinding	**"Crush Grinding"**
Friction Sawing	**Integrated Inspection**

Demonstrations can be arranged in your plant from DoALL's mobile demonstrations units.

Gage Blocks are integrated with a complete line of measuring instruments.



"Cool Grinding" and the DoALL Super Precision Grinder, 7 models.

27 Kinds BAND CUTTING TOOLS

for

Line Milling
Line Grinding
Contour Sawing
Friction Sawing
Continuous Filing
Polishing
Honing

The DoALL Company

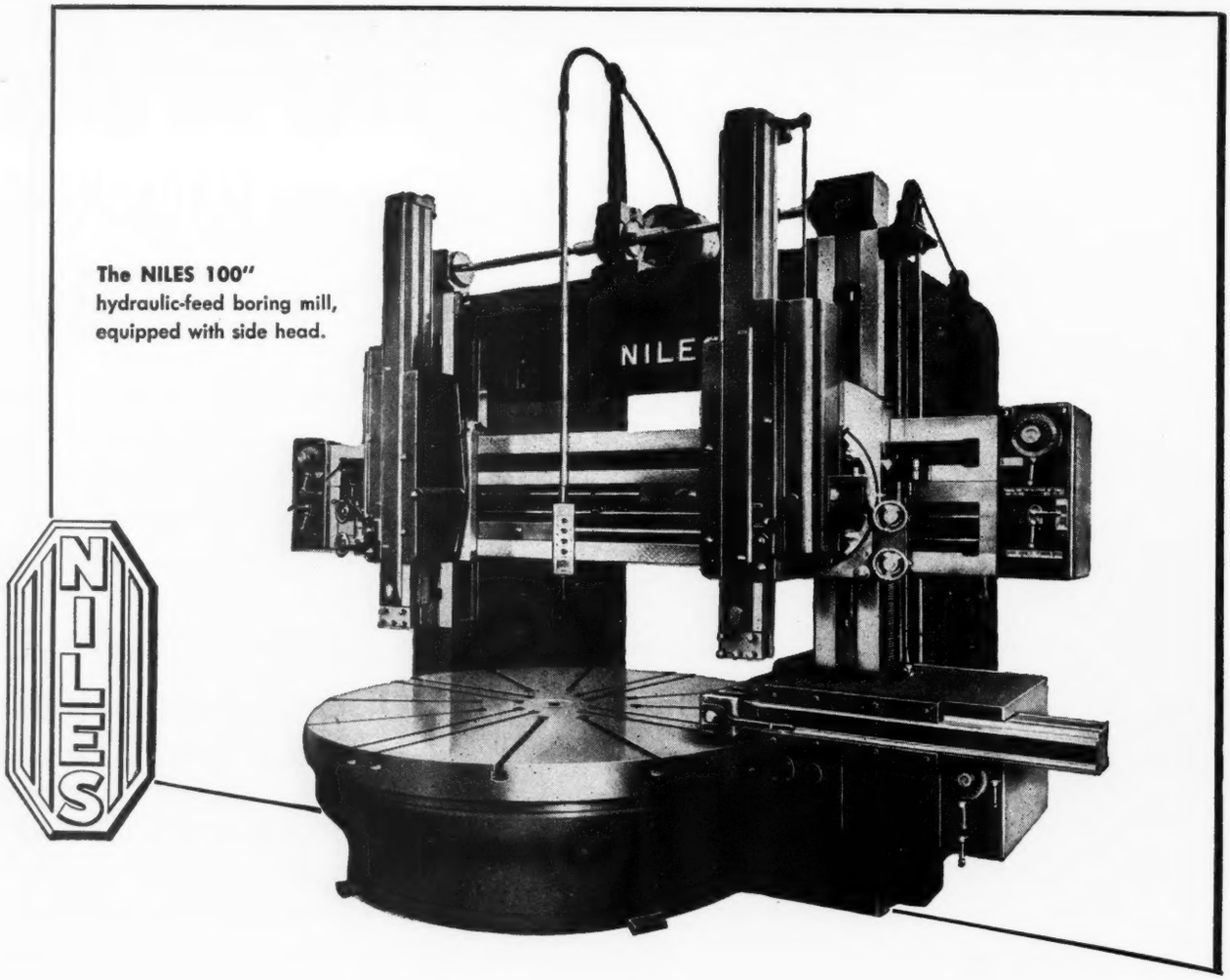
Des Plaines, Ill., U.S.A.

Cable Address DoALL Des Plaines

Representatives in 50 Countries

DoALL Stores in Key Cities

WRITE for literature and information That will give you . . .
FREE DEMONSTRATIONS IN YOUR PLANT
No obligation, of course.



The NILES 100" hydraulic-feed boring mill, equipped with side head.

NILES hydraulic-feed boring mills

Massive construction of Niles boring mills assures ample rigidity to take the stresses of high-speed cutting—yet with no loss of accuracy. You will get considerably faster boring and turning, particularly with tungsten-carbide tools.

With fingertip control of the hydraulic feed, your operator can effortlessly and efficiently operate his mill. He has, for example, infinite feed selection while the machine is running—he can make fast tool placements. Reduced operating fatigue will tend to improve his accuracy.

Eighty years of building large boring mills stand behind these new Niles machines. You will find them precision products in every respect, designed to give you better production—consistently.

* * *

Niles Vertical Boring Mills are built in all standard sizes from 72 inches up, with either hydraulic or mechanical feed and with or without side head. For further information, call the Lima-Hamilton sales offices in New York, Chicago or other principal cities, or write directly to Lima-Hamilton Corporation, Hamilton, Ohio.

LIMA HAMILTON CORPORATION

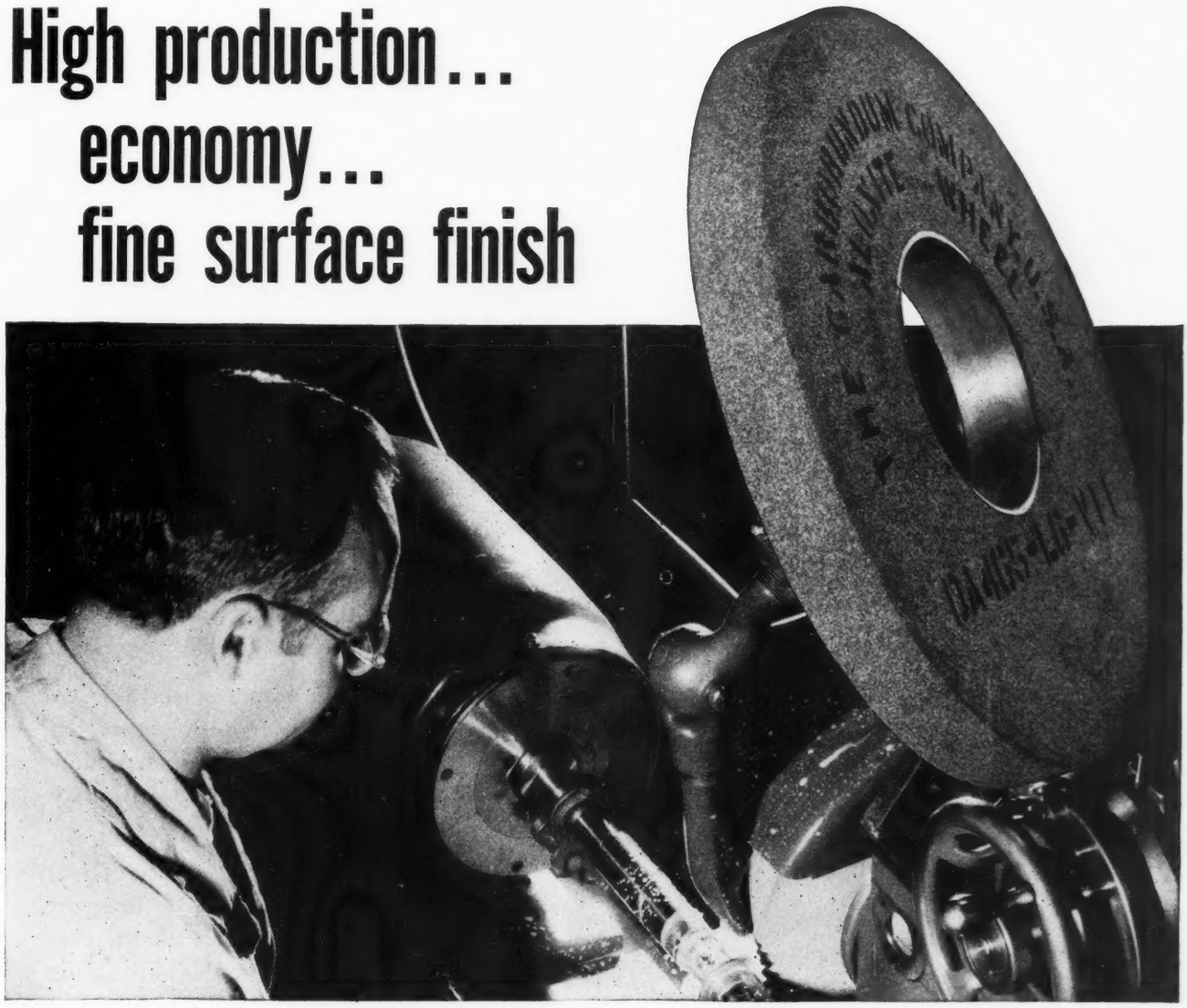
DIVISIONS: *Hamilton, Ohio* — Niles Tool Works Co.; Hooven, Owens, Rentschler Co. *Lima, Ohio* — Lima Locomotive Works, Inc.; Lima Shovel and Crane Division. *Middletown, Ohio* — United Welding Co.

PRINCIPAL PRODUCTS: Niles heavy machine tools, Hamilton diesel and steam engines, Hamilton heavy metal stamping presses, Hamilton-Kruse automatic can-making machinery, Locomotives, Shovels and cranes, Special heavy machinery, Heavy iron castings, Weldments.

For more information on products advertised, use Inquiry Card, Page 225

V 11 BOND Cylindrical Grinding Wheels

High production... economy... fine surface finish



V 11 Bond wheels by CARBORUNDUM offer cost-cutting production advantages in a wide variety of cylindrical grinding applications. A cool, free-cutting action is obtained because the physical properties of these wheels provide outstanding grinding characteristics. Reduced grinding pressures result in exceptional form holding qualities, greater accuracy, and faster cutting rates. Long service is secured by a self-dressing action.

One of these versatile wheels may be used to grind a large variety of materials. Or, it may be used for both heavy cuts and fine finishes. Wheel change set-up time is saved. Inventories of special and premium abrasives are minimized.

For complete details on the economical and efficient application of V 11 Bond wheels in your cylindrical grinding operations, ask your distributor for a copy of our new booklet or write direct. Bonded Products Division, The Carborundum Company, Niagara Falls, New York.

BRANCH OFFICES IN:

Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Jersey City, Philadelphia, Pittsburgh, St. Louis, San Francisco

Bonded Abrasives by

CARBORUNDUM

TRADE MARK

Making **ALL** *abrasive products... to give you the proper* **ONE**

"Carborundum" is a registered trademark which indicates manufacture by The Carborundum Company

REGULAR STYLE

PERPENDICULAR STYLE

Take a Tip: Take

TESTMASTER

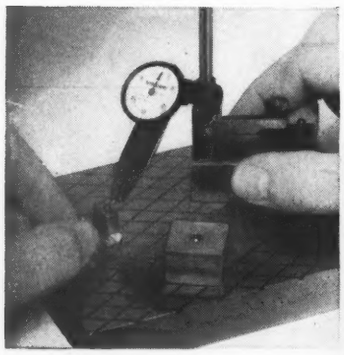
TRADE MARK REG U S. PAT. OFF.

Testmaster is no bigger than your thumb, yet it packs all the sensitivity and repeat-accuracy of a full-sized Dial Indicator. It has real adaptability. You can squeeze it into tight places. You can reverse the direction of the point travel. You can "see" into holes and around corners.

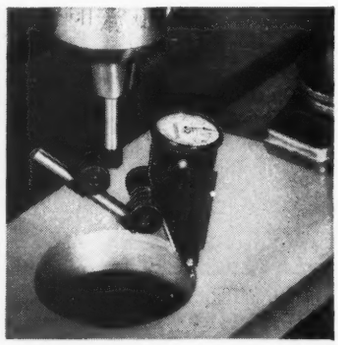
Testmaster is a tool you can trust because it's designed right and built rugged. In the tool kit, the tool crib, or on production gages, Testmaster gives top accuracy on a long-term basis.

Testmaster gives you the choice of two styles. Pick the Regular Style for most toolroom and test work. Pick the Perpendicular Style for setting up on jig borers, for positioning and checking drill jigs, or for any other jobs where the perpendicular Dial means extra visibility.

Testmaster comes in eight models. You can get the graduations you need, either English or Metric. Write for more information on Testmaster, today. Federal Products Corporation, 1118 Eddy St., Providence 1, R. I.



Regular Testmaster checking setup on surface plate.



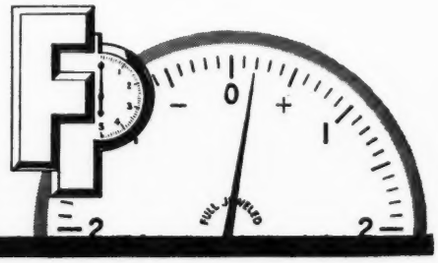
Perpendicular Testmaster gives "around the clock" visibility on jig borer work.

EIGHT MODELS TO CHOOSE FROM

Regular	Perpendicular	Graduated	Range	Price with case and holding device
Model 1	Model 5	.001"	.030"	$20.50
Model 2	Model 6	.0001"	.008"	$25.00
Model 3	Model 7	.0025mm	.2mm	$25.00
Model 4	Model 8	.01mm	.8mm	$20.50

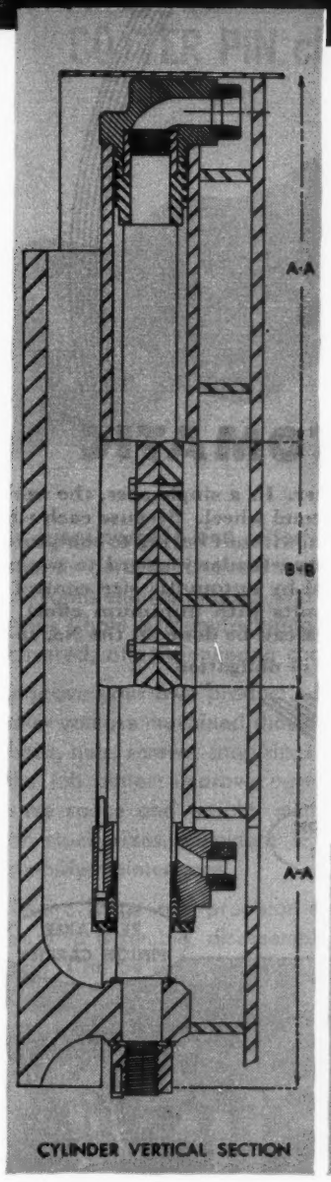
FEDERAL

Largest manufacturer devoted exclusively to designing and manufacturing *all types* of DIMENSIONAL INDICATING GAGES



For more information on products advertised, use Inquiry Card, Page 225

What engineering features are responsible for LAPOINTE LEADERSHIP in building BROACHING MACHINES?



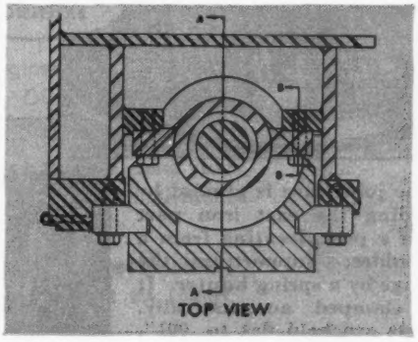
CYLINDER VERTICAL SECTION

HERE'S A LIFETIME CYLINDER!

TAKE A LOOK at this drawing and see for yourself what Lapointe engineering has accomplished. in building genuine two-fisted *ruggedness* into the cylinder of a vertical broaching machine.

The cylinder is made in *one* welded steel construction with side ears extending the full length. These are bolted to corresponding ears extending also the full length, and rigidly bolted and doweled to the frame — forming an amazingly strong shallow U-section. Naturally, *it cannot spring — and it maintains constant fit on the slide.*

THE CAST IRON PISTON has diesel engine-type piston rings. The rod is carburized hardened and ground to a fine finish, guided into bronze bushings and a standard packing gland.



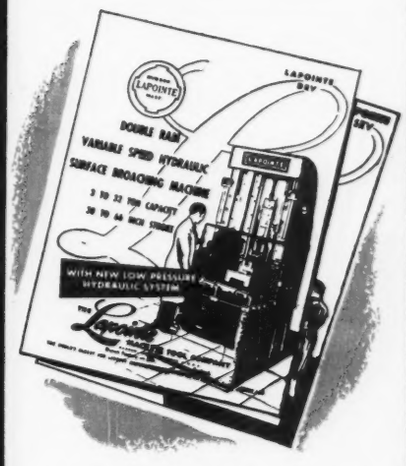
TOP VIEW

Cylinder caps are both fitted with O-ring seals for permanency.

This construction permits ZERO-MAINTENANCE on the cylinder!

COMPLETE ENGINEERING DATA

and dimensions on double ram and single ram LAPOINTE Vertical Broaching Machines will be found in these two illustrated bulletins. You are invited to send for Bulletins DRV-1 and SRV-1.



LAPOINTE Vertical Broaching Machines are all built to JIC Standards at no extra cost.

LAPOINTE takes the responsibility for the entire job — machines, tools, and fixtures. That's a big reason for Lapointe Leadership . . . that's why "Lapointe's the way to *better broaching!*"

THE Lapointe MACHINE TOOL COMPANY

HUDSON, MASSACHUSETTS • U. S. A.

Branch Factory • Edgware • Middlesex • England

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHES AND BROACHING MACHINES

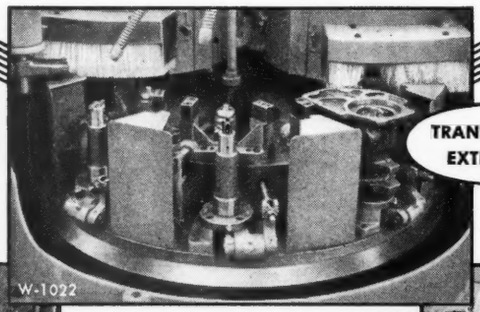
V-311

Put them on a Blanchard

NO. 16-A2 AUTOMATIC

This two-spindle surface grinder is a real producer. In a single pass, the work is roughed by one wheel and then finished by the second wheel. Because each wheel can be selected for its part of the grinding operation, without having to compromise between roughing and finishing, the No. 16-A2 is particularly suited to work requiring high production. Close limits are assured by automatic size control for each wheel. If you're looking for maximum results with minimum effort, get production details on just how fast your own work can be done on the No. 16-A2.

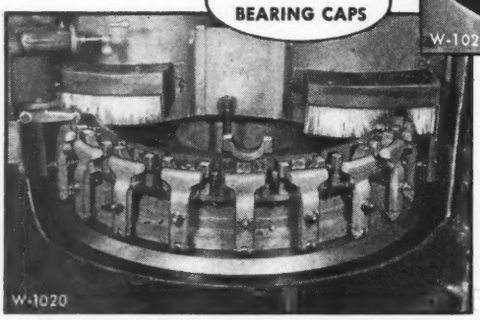
Send blueprints or samples — there is no charge or obligation.



W-1022

TRANSMISSION EXTENSION

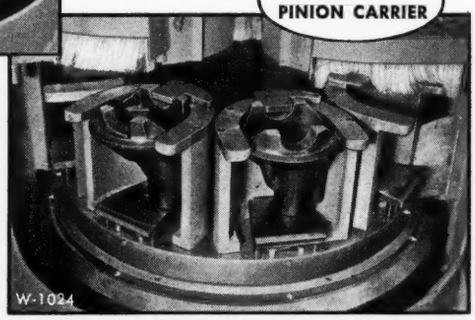
PINION CARRIER BEARING CAPS



W-1020

The joint face is ground by loading the cast iron part over a post, locating from a shoulder, supporting the flange by a spring bunter. It is clamped automatically. Parts are held flat to .001", square with bore to .002", and to ±.001" for size. 84 pieces ground per hour on one side.

REAR AXLE PINION CARRIER



W-1024

These cast iron caps are placed in suitable stations, automatically clamped, ground, and automatically unclamped. 1020 caps per hour are ground to ±.003", and flat to .002" in a 20 station fixture. 1/16" of stock is removed per side.

Send for your free copies of "Work Done on the Blanchard," third edition, and "Art of Blanchard Surface Grinding."

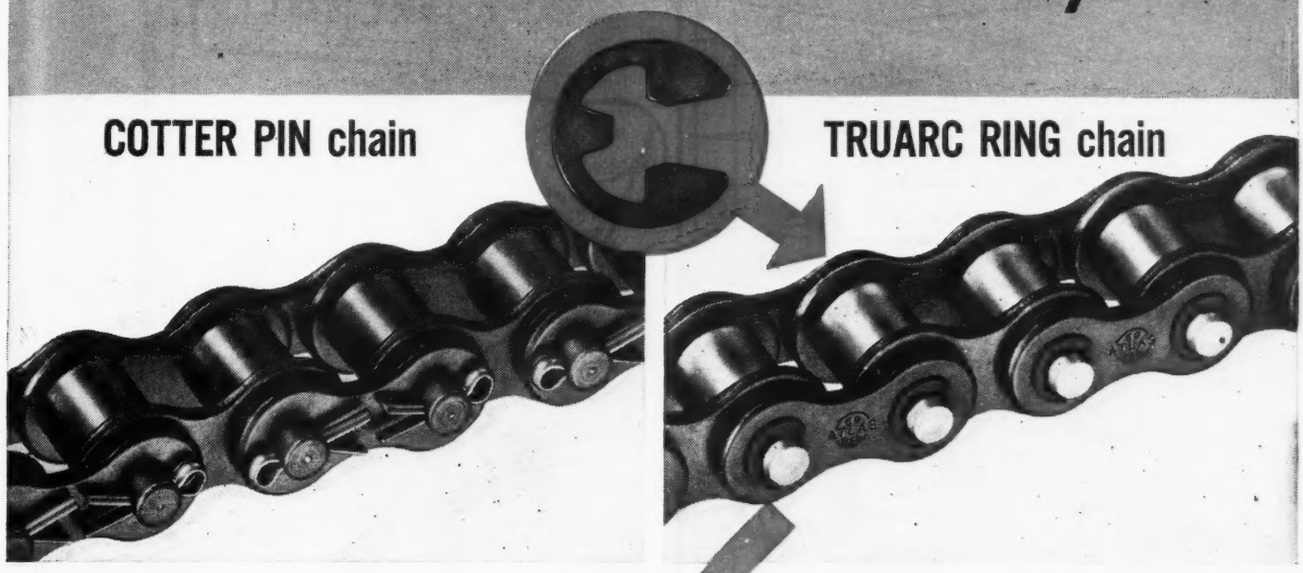
These cast iron parts are loaded with the flange under a "U" shaped block, clamped upward against the block. The four bearing surface "feet" are ground to limits of ±.003", parallel to flange within .001". 229 pieces are ground per hour on one side.

PUT IT ON THE BLANCHARD

THE BLANCHARD MACHINE COMPANY 64 STATE ST., CAMBRIDGE 39, MASS., U.S.A.

For more information on products advertised, use Inquiry Card, Page 225

Truarc E-Rings Improve Performance of Detachable Chain...5 ways!



In every possible kind of test—tensile, impact, shock, speed—detachable chain made with Truarc Rings outperforms chain equipped with cotter pins! That's what Atlas Chain & Manufacturing Co., Philadelphia, discovered, after pioneering chain with Truarc E-Rings.

Improve your own product with Truarc Rings! Wherever you use machined shoulders, collars, cotter pins, bolts, nuts, screws, snap rings...a Truarc Ring will do the job better: improve performance, cut unit cost, save space and weight, eliminate parts, permit use of stock sizes, eliminate skilled labor operations, simplify maintenance.

Truarc Rings are precision-engineered. Quick and easy to assemble, disassemble. Give a never-failing grip. Can be used over and over again.

Find out what Truarc Rings can do for you. Send your blueprints to Waldes Truarc engineers, for individual attention, without obligation.

Waldes Truarc Retaining Rings are available for immediate delivery from leading ball bearing distributors throughout the country.

1. STRONGER. Average 30% higher *static thrust strength* than cotter pins. Resilient E-Ring reinforces links against exceptional *side stress*—resilient spring is most efficient means of damping vibration.

2. GREATER SHOCK RESISTANCE. Higher *shock strength ratios* than cotter pins, due to greater contact surface plus spring reaction for damping moment of shock. Circular movement of ring in groove relieves *shock surface loadings* —instead of resisting rigidly as with cotter pins in fixed holes.

3. HIGH SHOULDER. High effective bearing shoulder extends practically all around pin, and is geometrically perfectly proportioned to link diameter.

4. RE-USABLE. No part of E-Ring fatigues and breaks off, as with ends of re-used cotter pins. Ring removes easily with screwdriver.

5. REDUCES ACCIDENTS. Does not protrude to catch onto clothing. No sharp-pointed ends to produce electrical brush discharge and resultant fire and explosion hazard in mines and mills.

SEND FOR NEW CATALOG

WALDES

TRUARC

REG. U. S PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS ARE PROTECTED BY THE FOLLOWING PATENT NUMBERS: U. S. PAT. 2,382,948; 2,420,921; 2,411,761; 2,487,803; 2,487,802; 2,491,306 AND OTHER PATS. PEND.

Waldes Kohinoor, Inc., 47-16 Austel Place
Long Island City 1, N. Y.

M082

Please send the new catalog on Waldes Truarc Retaining Rings.

Name_____

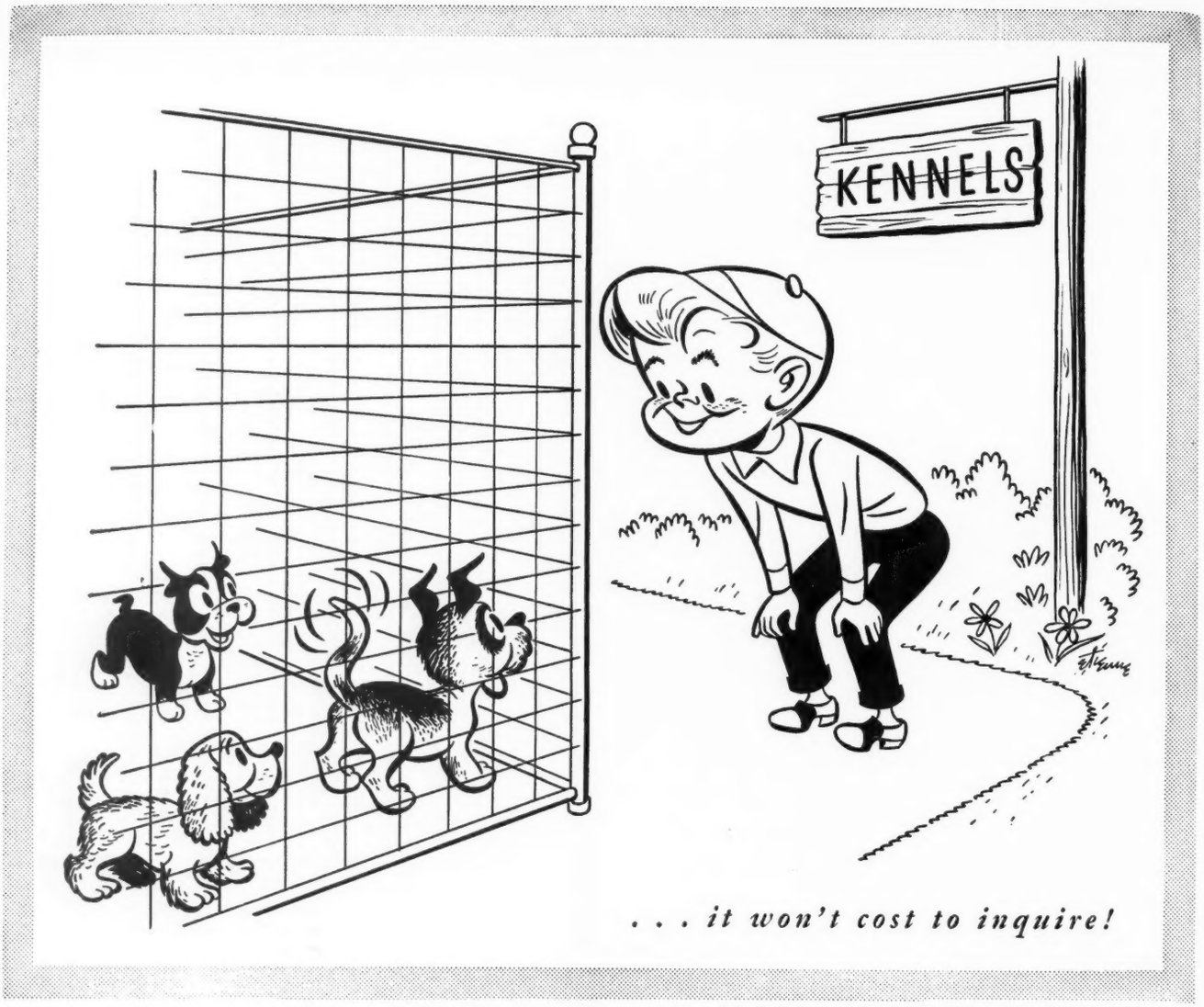
Title_____

Company_____

Business Address_____

City_____ Zone_____ State_____ ★

For more information on products advertised, use Inquiry Card, Page 225



YOU MIGHT SAVE MONEY BY FAST INSPECTION OF INTERNAL THREADS. Alert management is using Bryant Thread Gages and operational control in their threading departments to: 1) catch mistakes as they are made; 2) place responsibility fairly on operator, tools or machines; 3) provide a statistical record of regularly sampled parts showing the status and trend of the operation at all times.

The unique Bryant Thread Gages give a visual quantitative reading of accuracy within tolerances, or accumulative inaccuracies of lead, pitch diameter and thread form, or the presence of burrs. The Bryant squareness-of-face attachment shows relationship of face to pitch diameter.

One company, using Bryant Gages, proved that a sizable investment in new machines was unnecessary, and, most important, improved the accuracy and production of their threaded parts.

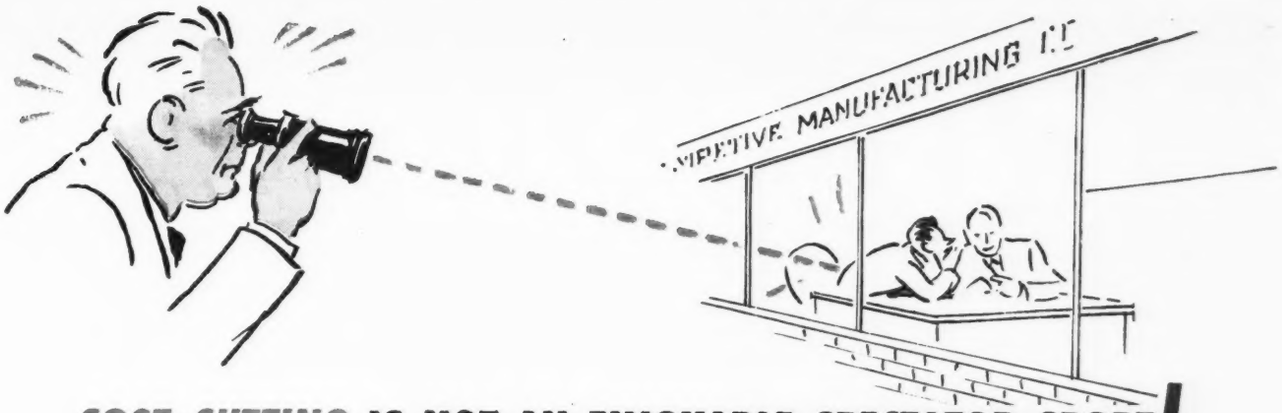
Let us show you, with facts and figures, how much money Bryant Gages can save you in just one year. It won't cost to inquire!

BRYANT

CHUCKING GRINDER CO.

SPRINGFIELD, VERMONT, U.S.A.

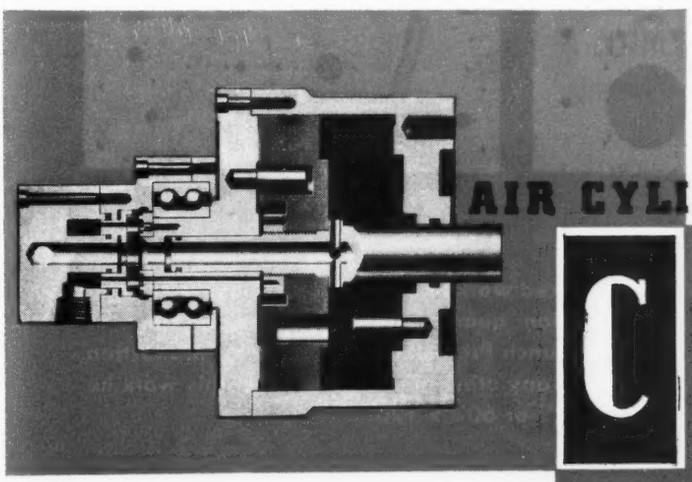
For more information on products advertised, use Inquiry Card, Page 225



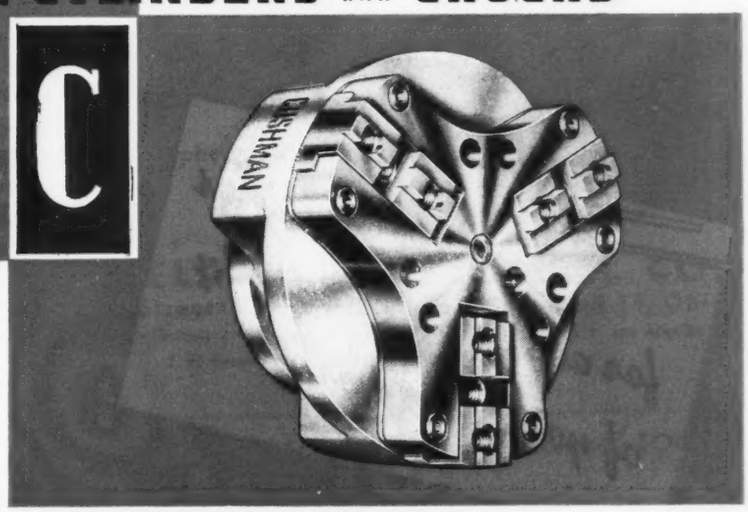
COST-CUTTING IS NOT AN ENJOYABLE SPECTATOR SPORT!

Of course, it's a great deal more interesting . . . and more profitable . . . to *lead* the way in getting your manufacturing costs down, than to have your competitor force you into it.

That is why we invite you to get the facts about ultra-modern Cushman Power Chucking methods and equipment NOW . . . without delay. Our engineering department is extremely busy showing a growing list of metal working shops how recent developments . . . like super-speed machining with Aluminum Body Power Chucks and Air Cylinders . . . can effect cost reductions that mean something in the final price structure. Write us at once for current bulletins or outline your tooling and production needs and we'll be glad to make recommendations.



CUSHMAN
High speed
ALUMINUM BODY
AIR CYLINDERS *and* **CHUCKS**



Raise your Speed limits
and lower your costs

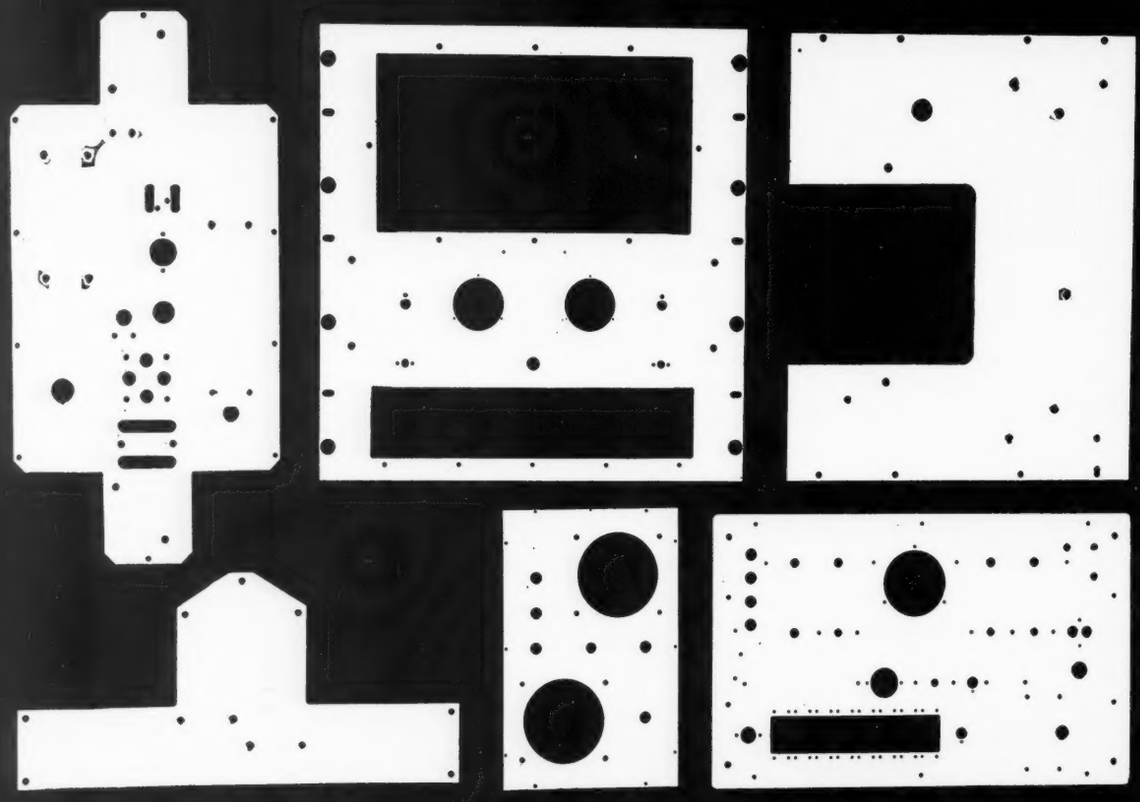
CUSHMAN

THE CUSHMAN CHUCK CO.
Hartford 2, Connecticut

9C850

CUSHMAN ALSO MANUFACTURES A COMPLETE SERIES OF WRENCH OPERATED CHUCKS . . . WRITE FOR CATALOG 64

COMPARE!



For pierced work like that shown above—in small production quantities—the Wiedemann line of Turret Punch Presses offers lower cost production than by any other method—whether this work be 6" x 12" or 60" x 120".

Send us drawings for accurate time study of your own work.

Capacity:—7½ to 150 tons
Throat Depth—12" to 60"
12 to 32 punches and dies set up in the turrets ready for use.
A high-speed gauging arrangement for every requirement.

WIEDEMANN MACHINE COMPANY

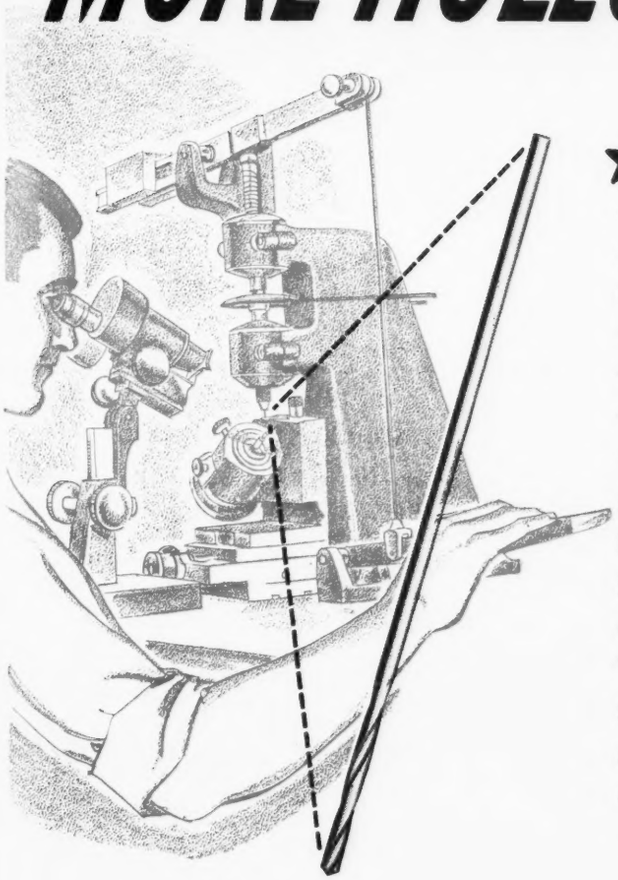
4205 Wissahickon Avenue • Philadelphia 32, Pennsylvania

For more information on products advertised, use Inquiry Card, Page 225

LARGE OR SMALL . . .

CLE-FORGE HIGH SPEED DRILLS GIVE YOU

MORE HOLES PER GRIND!

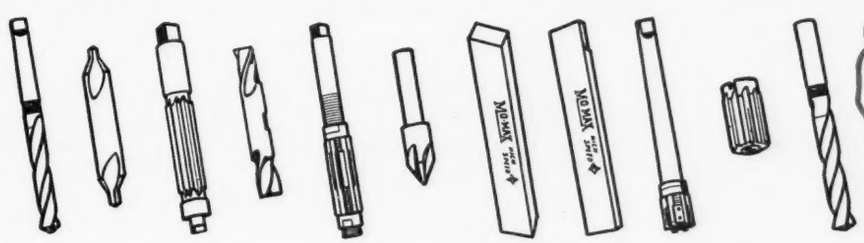


★ Did you ever sharpen a tiny drill .020″ in diameter? It's a tricky job, and makes you realize the importance of getting *more holes per grind.* ◈ A shop making jet nozzle parts of #347 stainless steel was having difficulty drilling very small holes. Drills were averaging less than 9 holes per grind. The job went slowly, and costs were high. ◈ When a ***Cleveland*** Service Representative was called in, he suggested switching to the CLE-FORGE High Speed Drill illustrated here (greatly enlarged), and changing the speed from 800 to 1200 R.P.M. The number of holes per grind *was increased to more than 50!* ◈ When *you* have a drilling problem, let a ***Cleveland*** Service Representative help you step-up production and cut your costs. Contact our nearest Stockroom, or . . .

Telephone Your Industrial Supply Distributor

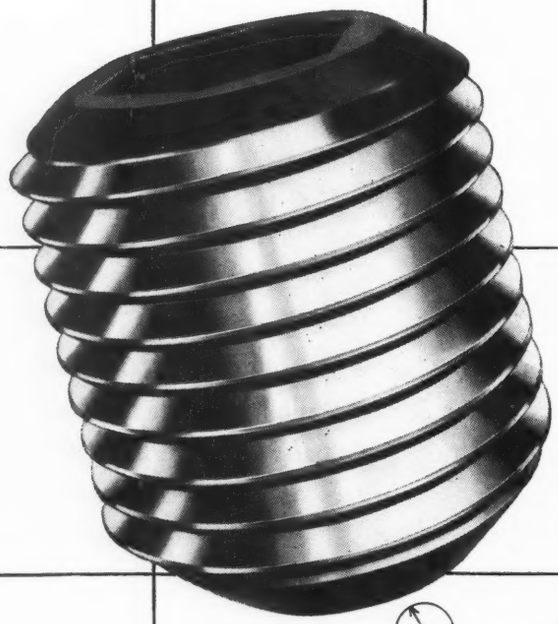
THE CLEVELAND TWIST DRILL CO.
1242 East 49th Street • Cleveland 14, Ohio
***Stockrooms:* New York 7 • Detroit 2 • Chicago 6 • Dallas 1 • San Francisco 5 • Los Angeles 58**
E. P. Barrus, Ltd., London W. 3, England

ASK YOUR INDUSTRIAL SUPPLY DISTRIBUTOR FOR THESE AND OTHER *Cleveland* TOOLS



Parker-Kalon GROUND THREAD Socket Set Screws

Give every department A LIFT

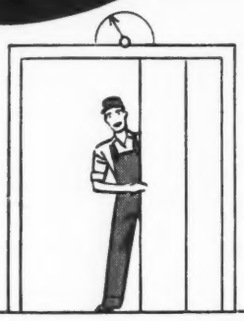


DESIGN

Ground Thread smoothness and accuracy plus faultless thread contour and lead make P-K Socket Set Screws first choice for a high quality product.

ASSEMBLY

Free from nicks, burrs and tool marks, P-K Ground Thread Socket Set Screws are consistently uniform and are made to close tolerances. Therefore they start easy, drive easy — keep assembly humming.



INSPECTION

With a dependable Class 3 Fit, every P-K Socket Set Screw is made of high-grade alloy steel, heat-treated to withstand severe torque and compression loads.

SEND FOR FREE SAMPLES

See and *feel* for yourself the difference thread grinding makes. Try them once, and see why so many Socket Set Screw users are switching to P-K. Parker-Kalon Corporation, 202 Varick St., New York 14, New York.

*TRADE MARKS REG. U.S. PAT. OFF.

SALES

Ground Threads, heretofore available only in precision equipment, provide an extra sales feature any shrewd buyer appreciates.

FOR ANY TYPE OF SOCKET SCREW —
REMEMBER — IF IT'S P-K* . . . IT'S O.K.
FLAT HEAD SOCKET CAP SCREWS • SIZE-MARKED SOCKET HEAD CAP SCREWS
• STRIPPER BOLTS • GROUND THREAD SOCKET SET SCREWS • PIPE
PLUGS • HEX KEYS • AVAILABLE THROUGH ACCREDITED DISTRIBUTORS

P-K TRADE MARK

PARKER-KALON*

cold-forged

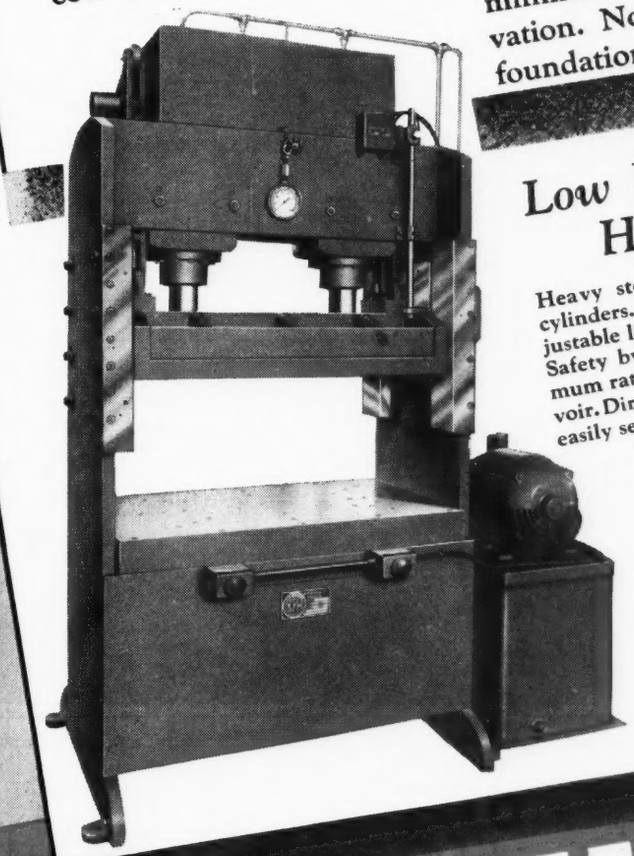
SOCKET SCREWS

For more information on products advertised, use Inquiry Card, Page 225

Standout performance for outstanding production economy

KRW HYDRAULIC PRESSES ENGINEERED FOR PLUS-PROFITS

Operational efficiency to chisel in on tough competition! Priced for terrific economy—quality that keeps on multiplying profits long after cost has been amortized. KRW Presses are self-contained and fabricated of steel for maximum strength, minimum weight and space conservation. No excavations or elaborate foundations required.



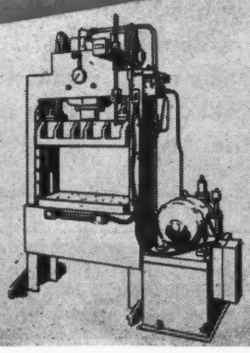
Low Price Gets High Priced Features

Heavy steel plate construction. Precision honed cylinders. Adjustable tonnage pressure control. Adjustable limit switch for top return position of ram. Safety by-pass prevents overloading beyond maximum rated capacity. Large self contained oil reservoir. Direct connected motor drive to pumps through easily serviced flexible couplings. Safety controls prevent accidents. Long bronze faced gibs adjustable for wear insure accurate travel of slide. Presses can be custom built to meet your manufacturing requirements. Quiet and vibrationless in operation. Write or wire for full facts and low prices.

Two Cylinder Type
Tons capacity 60 85 100. Platen and bolster, maximum usuable size, F to B, R to L, 36" x 60". Stroke 6" 11". Bed, fixed.
Controls; Manual, Semi-Automatic, Fully Automatic for cycled operation.

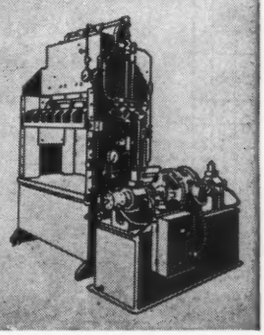
K·R·WILSON

215 MAIN ST. BUFFALO 3, N. Y.

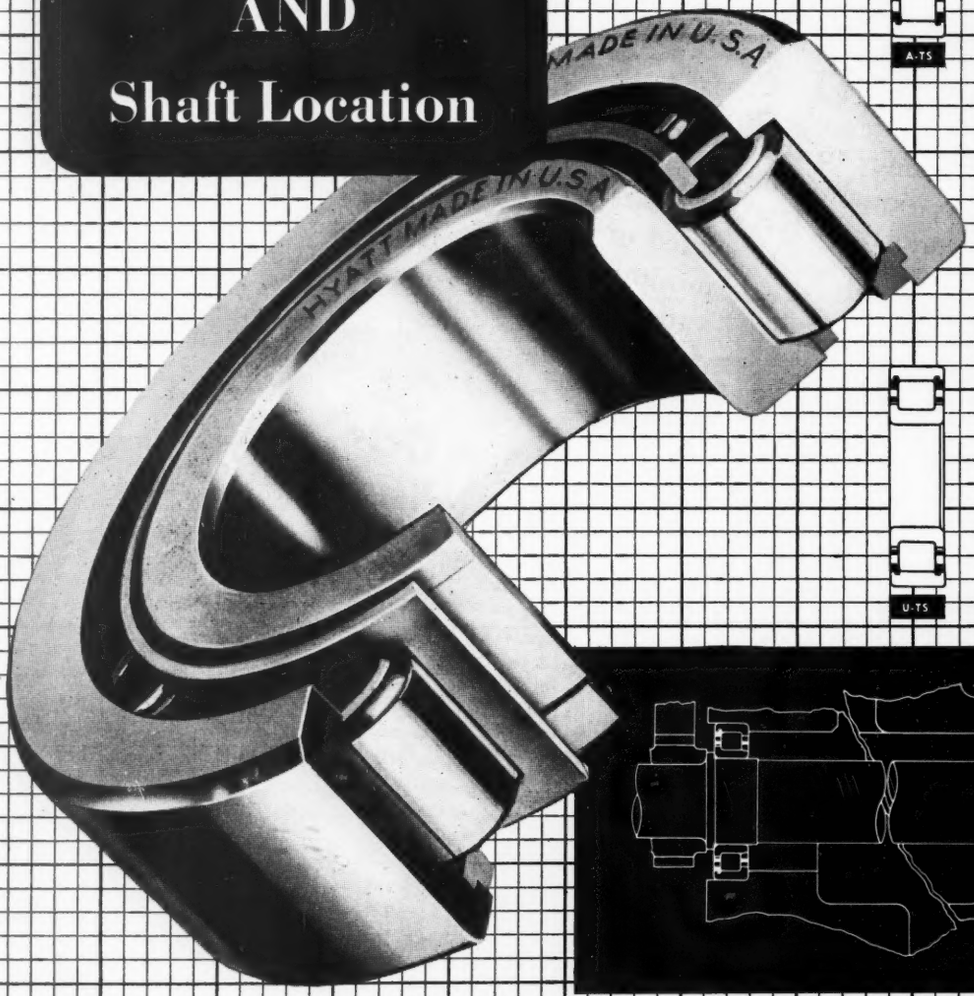


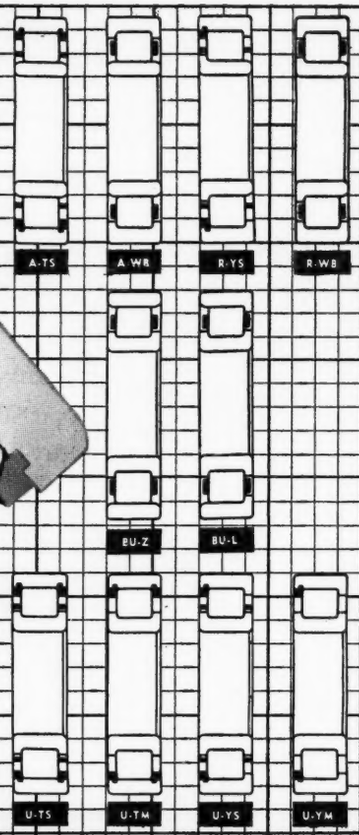
One Cylinder Type
Tons capacity 25 50 75 100 125 150. Platen and bolster, maximum usable size 24" F to B, 36" R to L. Stroke 6" 11" 18". Bed adjustment - increments of 6". Controls: Manual, Semi-Automatic. Fully Automatic for cycled operation.

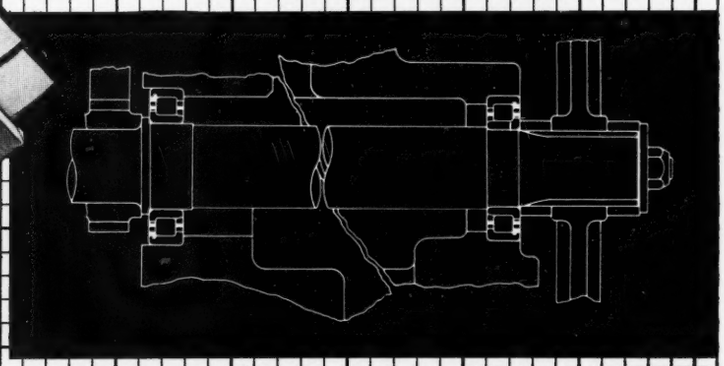
Three Cylinder Type
Tons capacity 75 100 125 150. Platen and bolster maximum usable size, F to B, R to L, 45" x 72". Stroke 6" 11". Bed, fixed. Controls: Manual Semi-Automatic Fully Automatic for cycled operation.



Hy-Load Capacity AND Shaft Location







The cut-away bearing illustrated is an "R-YS" type Hyatt Hy-Load Bearing. It not only provides the high radial capacity of a cylindrical roller bearing but when mounted in pairs, opposed as shown in the drawing above, will also locate shafts.

In the Hyatt Hy-Load line of cylindrical roller bearings there are ten different types, each designed to fulfill specific application needs. Of these ten types, four are made with separable inner races, two with separable outer races and four are non-separable, thus permitting wide flexibility in machine design and assembly procedures. A wide range of sizes are made in every type.

With this large selection of bearing types and sizes from which to choose, a designer can find a Hy-Load Bearing to fit almost any application need.

• • •

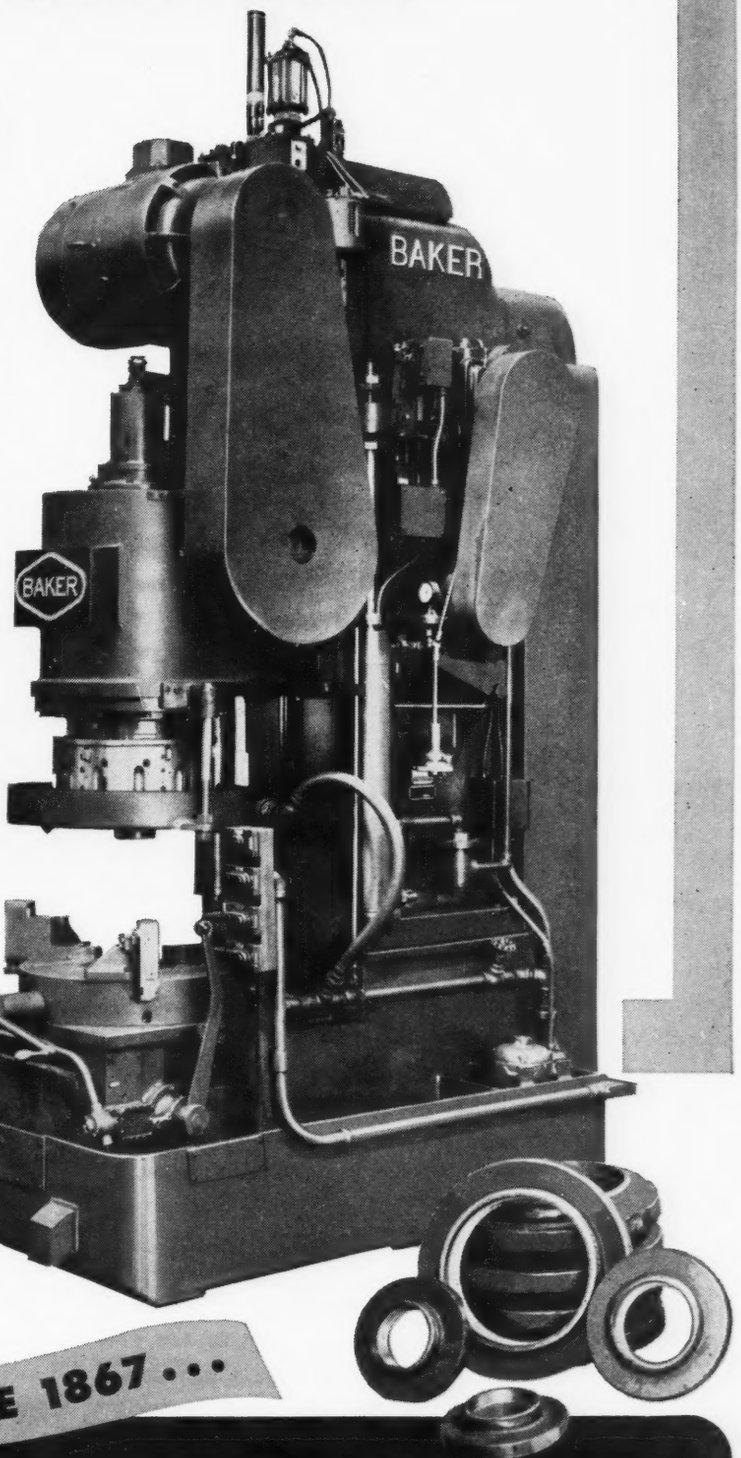
Full information about Hyatt Hy-Load Roller Bearings is contained in our Catalog 547 . . . a complete engineering guide to radial bearing selection and use. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

For more information on products advertised, use Inquiry Card, Page 225

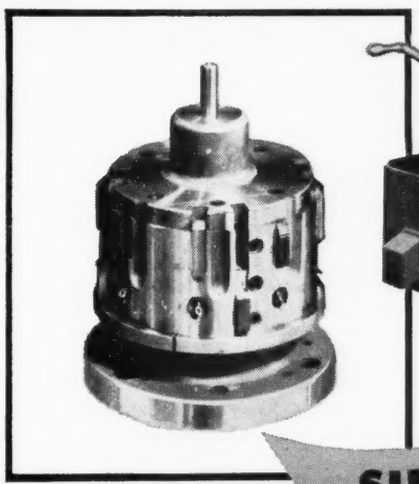
New BAKER

cuts operation time FROM 90 MINUTES TO LESS THAN 5 MINUTES PER PIECE



Boring, reaming, threading and counterboring operations on pipe flanges are accomplished in rapid succession with the new Baker 30H04 Boring and Threading Machine. All four operations are performed with reamer counterbore cutters and chasers in a specially adapted "Murchey" Full Receding Pipe Tap at one pass. Machine has lead screw feeding attachment. The work was previously done with a single point tool with work rotating.

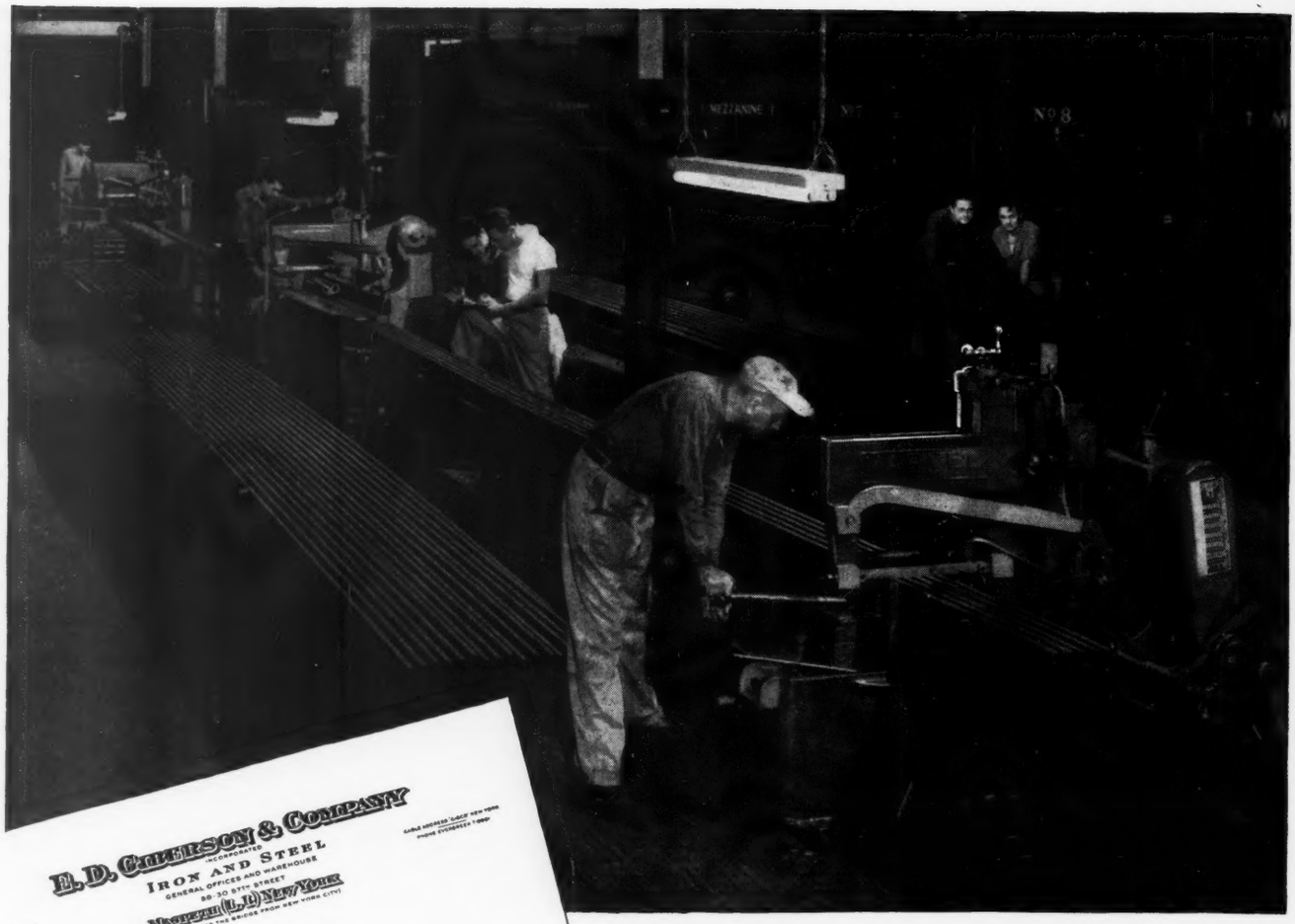
You too, can cut your production costs through *greater productivity.* Consult Baker engineers regarding your specific problem. Replace the old method with a time saving, cost cutting Baker Special Machine.

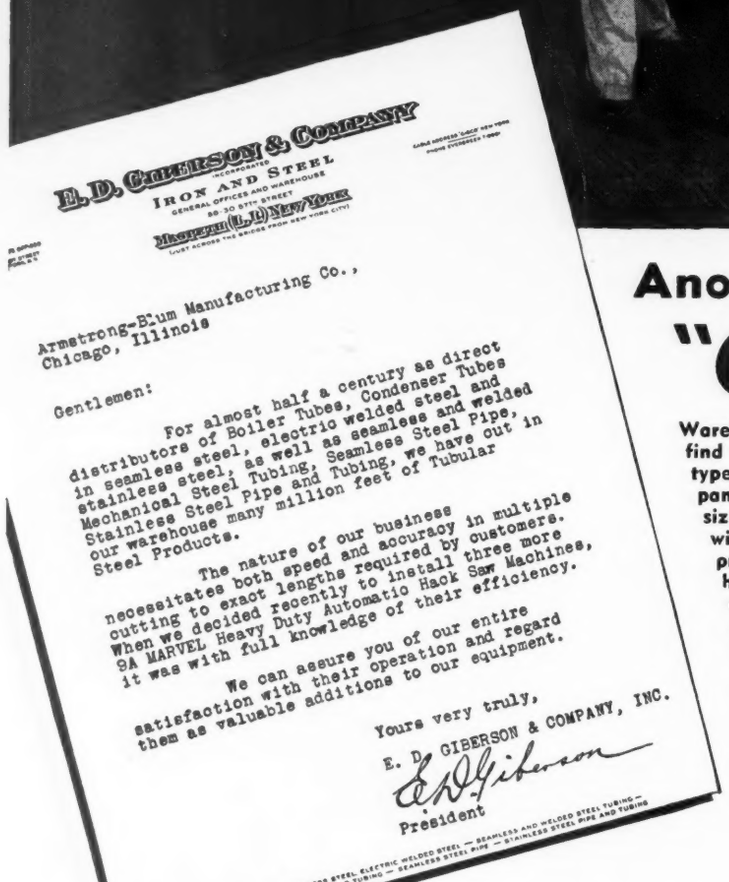


SINCE 1867 • • •

BAKER BROTHERS – Inc. TOLEDO OHIO

DRILLING, TAPPING, KEYSEATING & CONTOUR GRINDING MACHINES





E. D. GIBERSON & COMPANY
INCORPORATED
IRON AND STEEL
GENERAL OFFICES AND WAREHOUSE
50 - 30 57TH STREET
MASPETH (L. I.) NEW YORK
LONG ISLAND CITY JUST ACROSS THE BRIDGE FROM NEW YORK CITY

Armstrong-Blum Manufacturing Co.,
Chicago, Illinois

Gentlemen:

For almost half a century as direct distributors of Boiler Tubes, Condenser Tubes in seamless steel, electric welded steel and stainless steel, as well as seamless and welded Mechanical Steel Tubing, Seamless Steel Pipe, Stainless Steel Pipe and Tubing, we have cut in our warehouse many million feet of Tubular Steel Products.

The nature of our business necessitates both speed and accuracy in multiple cutting to exact lengths required by customers. When we decided recently to install three more 9A MARVEL Heavy Duty Automatic Hack Saw Machines, it was with full knowledge of their efficiency.

We can assure you of our entire satisfaction with their operation and regard them as valuable additions to our equipment.

Yours very truly,
E. D. GIBERSON & COMPANY, INC.
E. D. Giberson
President

PRESSURE TUBES IN SEAMLESS STEEL, ELECTRIC WELDED STEEL — SEAMLESS AND WELDED STEEL TUBING — LARGE O. D. SEAMLESS STEEL PIPE AND TUBING — SEAMLESS STEEL PIPE — STAINLESS STEEL PIPE AND TUBING

Another Tubing Warehouse "*Goes* MARVEL"

Warehouses that are not equipped with proper sawing machines find that the cutting of steel tubing (especially the stainless types) is a difficult and costly job. But E. D. Giberson & Company, New York, have cut off millions of feet of all types and sizes of steel tubing to accurate lengths, economically and without difficulty, due to the fact that they have long been properly equipped with MARVEL SAWS. And because they have found MARVEL SAWS so trouble-free, so reliable, so economical to operate and so universally suited to all their cutting-off jobs, they have recently added this row of three new MARVEL No. 9A Automatic Hack Saws. With this additional equipment, they have expanded their facilities and can more promptly serve their fast-growing list of satisfied customers with steel tubing of all types and sizes, "cut to customer's specified lengths."

The local MARVEL Field Engineer will be glad to study your range of cutting-off work—whether it be in pipe, structural shapes, bars, or the toughest and largest alloy billets—and will then make recommendations on how you can improve your cutting-off operations to reduce costs and increase man-hour output.

Just write us on your letterhead: "Without cost or obligation on our part, send your local Field Engineer to look over our cutting-off operations."

MARVEL *Metal Cutting* SAWS
Better Machines–Better Blades

see our CATALOG in SWEET'S FILE MECHANICAL INDUSTRIES

ARMSTRONG-BLUM MFG. COMPANY

5700 BLOOMINGDALE AVENUE **"The Hack Saw People"** **CHICAGO 39, U. S. A.**

For more information on products advertised, use Inquiry Card, Page 225

. . . at WESTERN ELECTRIC Telephone Exchange Parts Precision Broached on Oilgear Machines

■ Oilgear Broaching Machines have been used by the Western Electric Company plants for many years . . . in some cases as far back as 1928. This great telephone and communications equipment manufacturer uses Oilgear Horizontal and Vertical Broaching Machines for finishing many delicate precision parts that go into telephone exchange assemblies.

In the scene above, three Oilgear single slide vertical surface broaching machines are used to finish various types of magnetic core pins. The first two machines finish broach two flats and a groove on 4 pins per cycle. Production on each machine is in excess of 1600 pieces per hour. The third machine broaches on each pass four 23/32″ flats which have been butt-welded to round pole pieces. Production is better than 400 pieces per hour.

Oilgear Broaching Machines have many features which are available only on Oilgear Machines *at no extra cost*. Here are some of these features. Oilgear two-way reverse flow variable delivery pumps have an efficiency of 90% at full load. You get higher, independently adjustable, cutting and return speeds, and positive broaching speed up to 150% overload. The patented electro-hydraulic control is integral with the pump and eliminates valves and piping. Power is *saved* because power is *used* only in proportion to the load . . . because power is reclaimed on return stroke . . . because there are no valves to waste power. The Oilgear system is a simple system. It uses less piping, is accessible yet compact. Wider slides and tables on Oilgear Machines allow broaching of 2 or more parts per cycle. Oilgear also has longer tool slides, and longer ways. Pre-loaded work tables offer closer broaching tolerances and smooth, harmonic operation. For further information, write: THE OILGEAR COMPANY, 1569 W. Pierce St., Milwaukee 4, Wisconsin.

Oilgear PIONEERS IN FLUID POWER

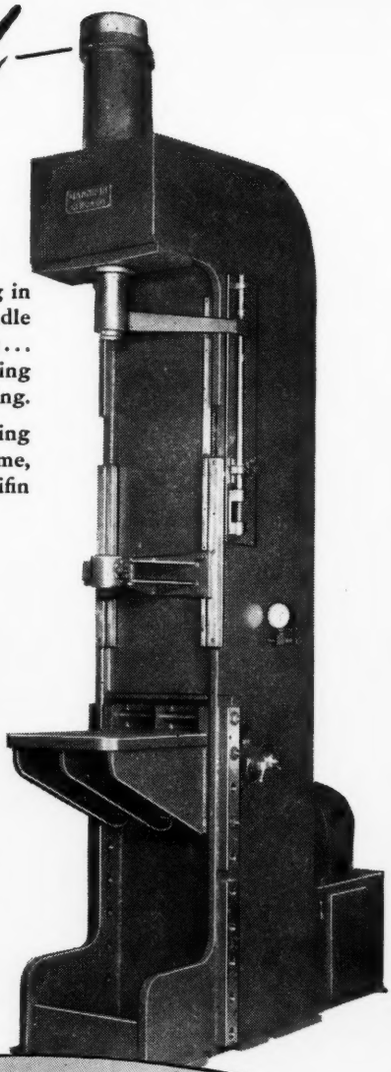
BROACHING MACHINES AND PRESSES

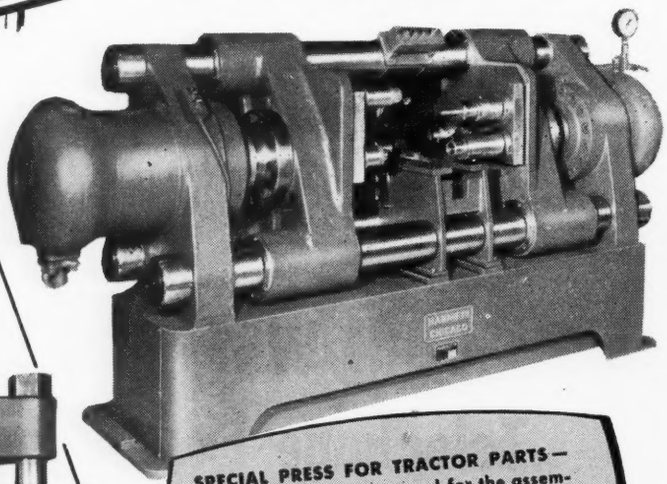
HANNIFIN *Engineered*—

TO SOLVE SPECIAL PROBLEMS!

Here are typical examples of the work Hannifin is doing in building automatic and semi-automatic hydraulic presses to handle standard and special production jobs: press fit assembling... shaping...straightening...forcing...molding...riveting...testing ...loading...gear quenching...broaching...forming.

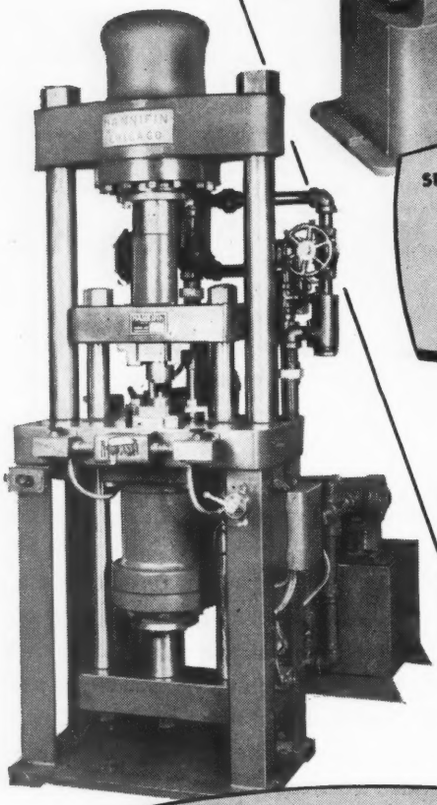
Hannifin offers an expert engineering service in designing and producing presses that can help you cut costs, save time, and do a better job. For recommendations, call in Hannifin engineers or submit specifications.





SPECIAL PRESS FOR TRACTOR PARTS—100-ton duplex press used for the assembly of track link pins for maker of crawler type tractors. Links are fed through and indexed. Left hand press ram advances, followed by right hand ram. Entire cycle is automatic.

SPECIAL PRESS FOR TESTING AIRPLANE STRUTS—20-ton open gap Hannifin hydraulic press with table adjustable for height. Reciprocation of ram is automatic up to a rate of 20 cycles per minute. Accommodates struts up to 136" in length for testing.



SPECIAL PRESS FOR ELECTRIC MOTOR COMMUTATORS—30-ton press with 20-ton clamp cylinder below table. The lower cylinder clamps the work and the upper cylinder follows down and performs riveting operation. Reverses automatically when riveting is accomplished.

HYDRAULIC PRESSES

THE HANNIFIN line includes a total of 75 different standard models in sizes up to 150 tons. Hannifin design readily permits modifications or variations from standard at moderate cost. Table size, gap, reach, control equipment, and ram speed can be altered easily to suit special conditions. For detailed information, send for a copy of 20-page Bulletin No. 130.

HANNIFIN CORPORATION

1109 S. Kilbourn Ave. Chicago 24, Illinois

AIR CYLINDERS • HYDRAULIC CYLINDERS • HYDRAULIC PRESSES
PNEUMATIC PRESSES • HYDRAULIC RIVETERS • AIR CONTROL VALVES

Nationwide Sales and Service

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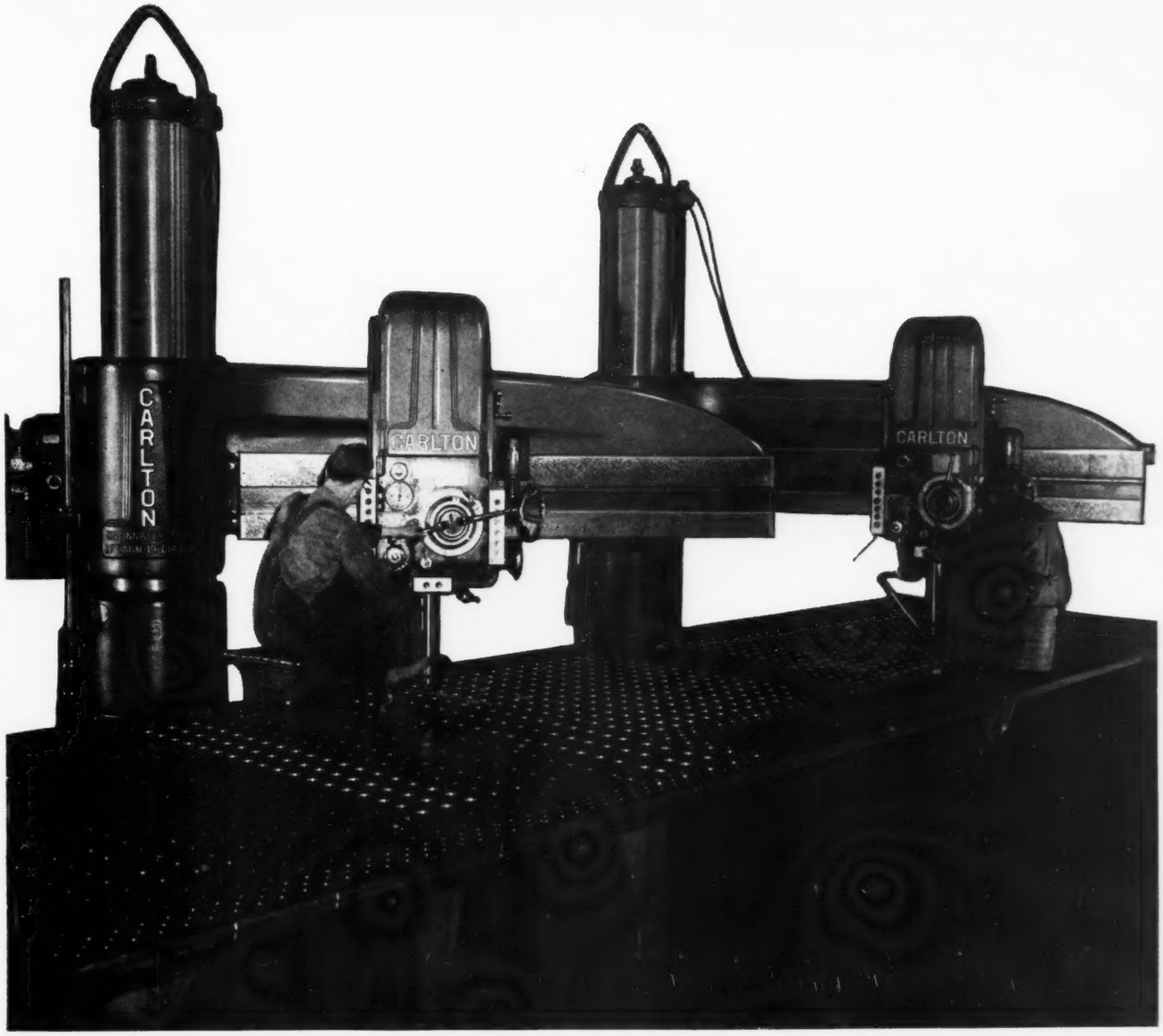


for LARGE-AREA *drilling and boring . . .*

rely on CARLTON RADIALS

IT'S a cinch that when drilling and boring extends over a big area, Carltons do the job better. Use them in tandem like the two Carlton 4-A radials shown above drilling and boring boiler plate . or perhaps a single Carlton with track-type mounting would be better for your requirements. Either way, Carltons . . . with their easy, push-button operation and rugged construction . . . are your best radial investment. Get the "hole" story, send today for descriptive bulletins.

THE CARLTON MACHINE TOOL CO.

CINCINNATI 25, OHIO

THE CARLTON MACHINE TOOL CO.

How do your employees WANT to invest their savings?

People are *more than twice as inclined* to invest their extra money in Savings Bonds as in any other form of savings or investment, according to the 1949 Survey of Consumer Finances*. That's adequate proof that your employees want your company to have the Payroll Savings Plan, by which they get the convenience of obtaining bonds regularly and "automatically"— delivered with their pay checks.

More than 20,000 companies operate Payroll Savings. The managements of these companies know it's "good relations" to provide this convenience. They can *see* the company-benefits in improved worker efficiency and stability. They know, too, that it's "good business"—because Payroll Savings boosts Bond sales, and Bond sales create a huge backlog of purchasing power that's "business insurance" for the years ahead.

Of course every Bond buyer builds financial independence because his Bonds at maturity will return $4 for every $3 he invests. Holding Bonds, moreover, helps him to realize he's making a profit on his job . . . makes him more resistant to influences which are unfavorable to our economic system.

It's *easy* to install Payroll Savings

Don't think that installing Payroll Savings is "a lot of work." All you need to do is appoint one of your top executives as Savings Bonds Officer and tell him to get in touch with your State Director, Savings Bonds Division, U. S. Treasury Department. The State Director will provide application cards, promotional material, and as much personal help as necessary. Remember—Payroll Savings *pays!*

**Sponsored by the Board of Governors of the Federal Reserve System and conducted by the University of Michigan. Based on 3,500 interviews in 66 sampling areas throughout the nation.*

The Treasury Department acknowledges with appreciation the publication of this message by

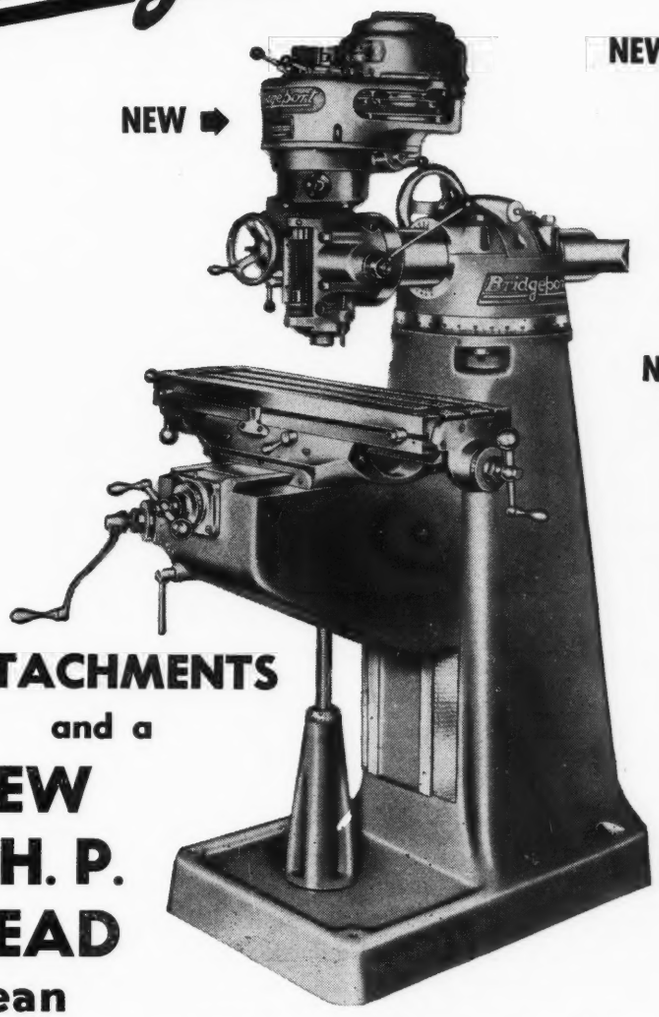
MACHINERY

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and The Advertising Council.

For more information on products advertised, use Inquiry Card, Page 225

Bridgeport

NEW ➡



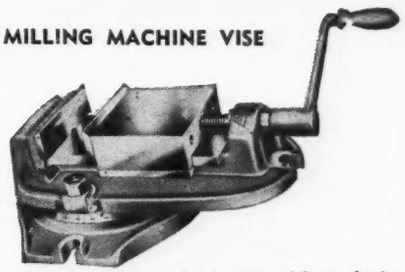
ATTACHMENTS and a NEW 1 H. P. HEAD mean greater utility and capacity with BRIDGEPORT TURRET MILLING MACHINES

Not only has the capacity of this universally accepted machine been increased but also its utility. Many more operations can now be conveniently handled with speed and accuracy. Each new attachment has been specifically developed for use on the Bridgeport Turret Milling Machine. Thus the thousands of machines now in service can be modernized with these new attachments, still further increasing the return on the original investment in "Bridgeports."

Complete details available promptly on request.

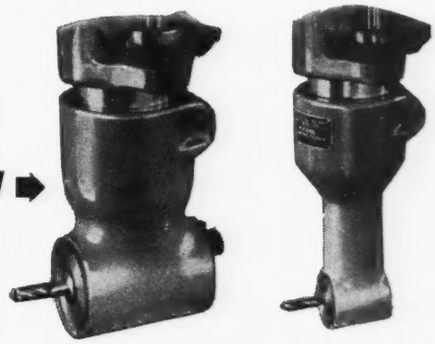
MILLING MACHINE VISE

NEW ➡



An improved, streamlined vise with coolant trough. Greater gripping power assured by large diameter screw.

NEW ➡

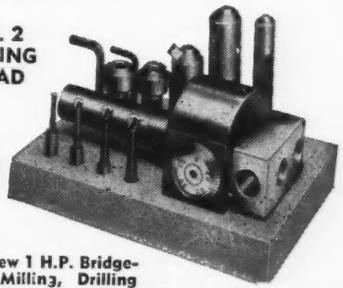


(Left) HEAVY DUTY RIGHT ANGLE ATTACHMENT—Designed for milling and drilling at right angles. Available for both Master and 1 H.P. Milling Heads.

(Right) LIGHT DUTY RIGHT ANGLE ATTACHMENT—For milling and drilling narrow, deep molds and cavities.

No. 2 BORING HEAD

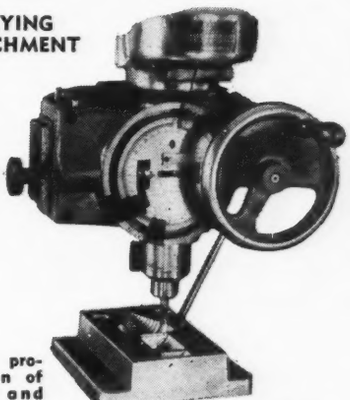
➡ NEW



Fits new 1 H.P. Bridgeport Milling, Drilling and Boring Attachment. Boring Tools and holder furnished make it possible to bore holes up to 6" diameter.

CHERRYING ATTACHMENT

➡ NEW

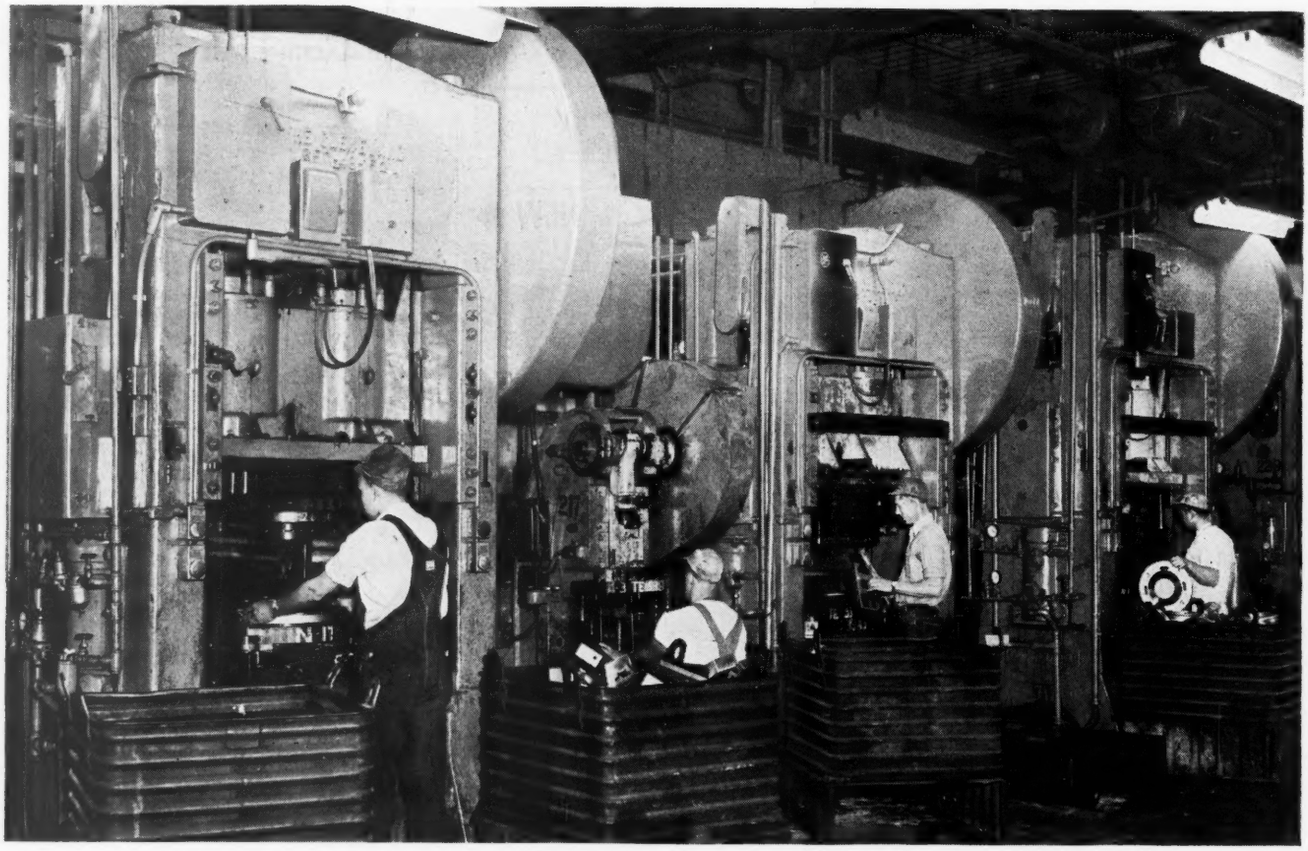


Makes production of convex and concave shapes possible. Ideal for producing drop forge dies, molds, cavities, metal core boxes, etc.

Bridgeport MACHINES, INC.

Bridgeport, Connecticut

Manufacturers of High Speed Milling Attachments and Turret Milling Machines



Cleveland Double Crank Presses form lighter parts in A. O. Smith Corporation's new production line.

A. O. SMITH Corp. chooses CLEVELANDS again!

Recently, at their Kankakee Works, the A. O. Smith Corporation decided to produce several parts that they had been purchasing. This decision required the addition of a battery of 5 new presses. We are justifiably proud that, on the basis of production performance, Clevelands were chosen. It was recently reported, by this well-known corporation that, "Every Cleveland Press in the entire line is performing exceptionally well and is very satisfactory in every respect."

This report is typical of the comments made about Cleveland Presses by leading Press users. If you do forming, blanking, trimming, punching, drawing or similar operations, let us show you how you can do a faster, more economical job with a new Cleveland Press.

We will gladly furnish you with information on any type or size of Press . . . our engineers will gladly work with you on special problems.

A-3262

PUNCHING TOOLS & DIES

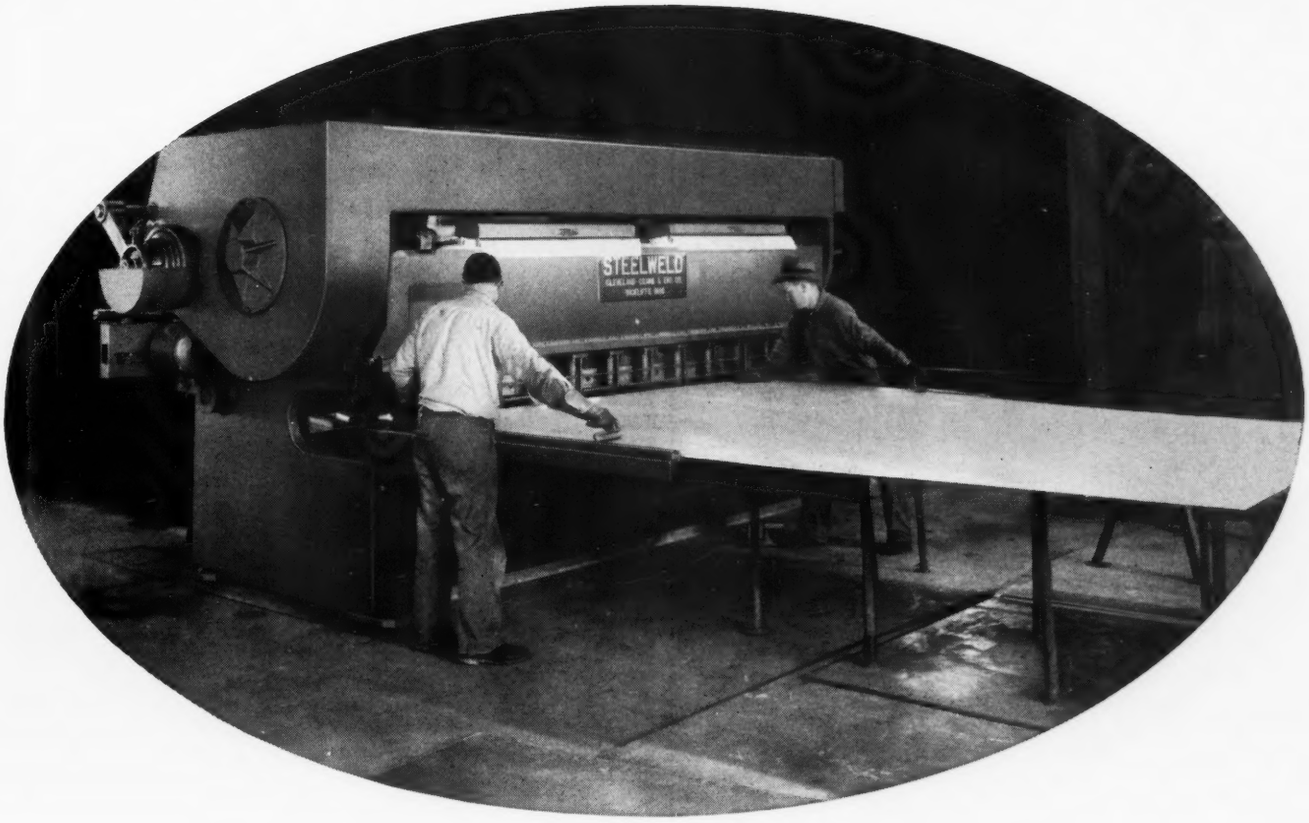
OFFICES AT:
NEW YORK . . . CHICAGO
DETROIT . . . . PHILADELPHIA
PITTSBURGH

THE CLEVELAND PUNCH & SHEAR WORKS CO.
U. S. A.
Established 1880
• • • • • • POWER PRESSES • • • • • •

FABRICATING TOOLS

CLEVELAND 14, OHIO

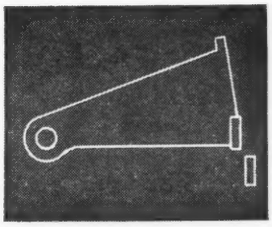
For more information on products advertised, use Inquiry Card, Page 225



PIVOTED-BLADE MAKES SHEARING

Fast . . Easy . . Accurate

Because of the pivoted-blade design, Steelweld Shears have several outstanding advantages heretofore unavailable in any shears at any price, which make shearing fast, easy, accurate:



EASY KNIFE ADJUSTMENT

A direct result of this design is the easy knife adjustment it makes possible. Knife clearance is quickly made to suit every plate thickness by simply turning a crank until pointer in an indicator is set for the metal to be cut. No bolts to loosen; no parts to move.

ELECTRIC FOOT CONTROL

This feature eases the operator's work because the foot switch requires practically no effort to operate and can be slid around to wherever most convenient to use. It has been adopted as standard for all Steelweld Shears.

ALL-WELDED ONE-PIECE FRAME

Only because of the pivoted-blade design, was it possible to weld all parts of the frame into one solid integral unit. As there is no need of moving the bed to adjust for knife clearance, it, too, is welded permanently to the end housings. Since there are no bolted connections to loosen and misalign, deflections are minimized and long-time accuracy assured

MANY MORE IMPORTANT FEATURES

These are a few of the features. There are many more. When you get the facts you will agree that no other shears compare with Steelwelds.

GET THIS BOOK!

CATALOG No. 2011 gives construction and engineering details. Profusely illustrated.

THE CLEVELAND CRANE & ENGINEERING CO.

5413 EAST 282ND STREET, WICKLIFFE, OHIO.

STEELWELD PIVOTED BLADE SHEARS

Speed-Up Stamping Operations and Get Longer Die Life with V&O PRESSES

Engineered for the Job!

Made in sizes from 3 to 105-ton capacity—inclinable type. Faster stamping operations... longer die life—assured by many advanced engineering features, including the long slide. Write today for our new Catalogue—and tell us your stamping problem.

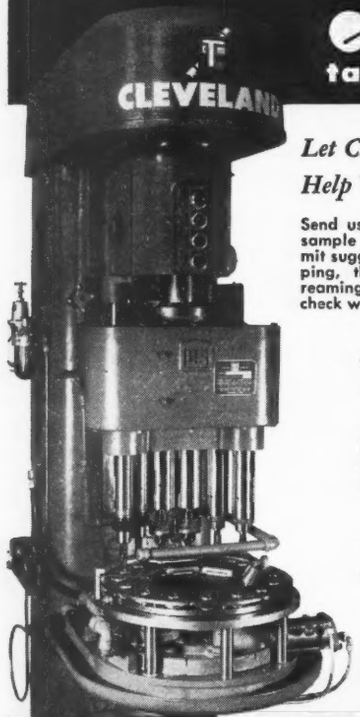
THE V&O PRESS COMPANY
DIVISION OF ROCKWELL MANUFACTURING CO.
HUDSON, N.Y.

Speed Assemblies with GRANT Noiseless Rivet Spinners

For speedy fastening with any kind of rivet up to 5/8" head diameter . . . for uniform loose rivets that will not bind . . . or smooth tight rivets that will not work loose—Grant Noiseless Rivet Spinners are a practical, inexpensive, versatile solution of your fastening problems. Whatever your fastening problems, send parts or prints and get Grant recommendations first.

The Grant Mfg. & Machine Co.
N.W. Station Bridgeport 5, Conn.

CLEVELAND lead screw tapping machines



Let Cleveland Engineers Help You Cut Tapping Costs

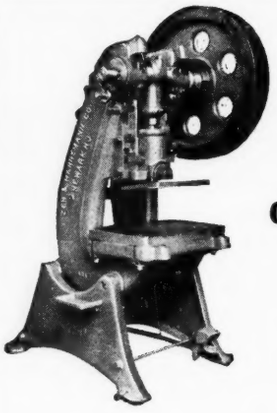
Send us your prints, specifications, or sample parts and let our engineers submit suggestions for cutting costs of tapping, threading, drilling, spot-facing, reaming, chamfering...no obligation... check with Cleveland first.

Check These Features

- √ Hardened and Precision Ground Lead Screw. No Hold Downs Required...just stop rotation of part
- √ Precision depth control
- √ Exclusive super-sensitive clutch
- √ Easily changed spindle speeds
- √ Fully Automatic or Manual Control Fast . . . Accurate . . . Dependable. One hole or many . . . one pitch or many
- √ Positive coolant and lubricant supply
- √ Maximum safety for operator and machine

Write Today for "The Production Tapping Guide" and Catalog 283-F

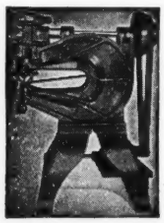
THE CLEVELAND TAPPING MACHINE CO.
A Subsidiary of Automatic Steel Products, Inc.
CANTON 6, OHIO



POWER PRESSES

of all types and sizes

ZEH & HAHNEMANN CO.
182 Vanderpool Street
NEWARK, N. J.



GRAY TURRET HEAD METAL CUTTER OR NIBBLER

GRAY, Originator of First Practical Metal Cutter or Nibbler. Received N.A.M. Pioneer Award.

Most modern Nibbler for Template Cutting, Tool Rooms, Shipbuilding, Aircraft Parts, Aircraft Tubing, Sheet and Plate Shops.

GRAY MACHINE CO., Box 596, PHILADELPHIA, PA.

AUTOMATIC MACHINERY BAIRD STRATFORD CONNECTICUT, U.S.A.

MULTIPLE SPINDLE LATHES
MULTIPLE SPINDLE GRINDERS
WIRE FORMING MACHINES
FOOT AND POWER PRESSES
TUMBLING EQUIPMENT

THE BAIRD MACHINE COMPANY
STRATFORD, CONN.

For more information on products advertised, use Inquiry Card, Page 225

It could only happen in Cincinnati.....

MACHINE tool center of the world, Cincinnati boasts that its citizens are providing worthwhile solutions to many machining problems. The U. S. Drill Head Company's engineers have for many years been leaders in their field, manufacturing all types of multiple spindle, fixed center, adjustable and lead screw tapping heads.

The photograph at the right, is a U. S. Drill Head adjustable head, available in 56 sizes and 5 types. It is mounted on a tapping unit for a machine that does not have a reversing spindle.

U. S. Drill Head can equip the spindles with single purpose tap chucks, floating tap holders, or safety tap holders, which prevent tap breakage and permit the hole to be tapped to the bottom without any breakage.

By locking the tapping unit the complete setup can be used for drilling also. Compactly designed, this heavy-duty tool is adaptable to any drilling machine, round quill, or flange type spindle.

• Write for New 1950 Catalog.

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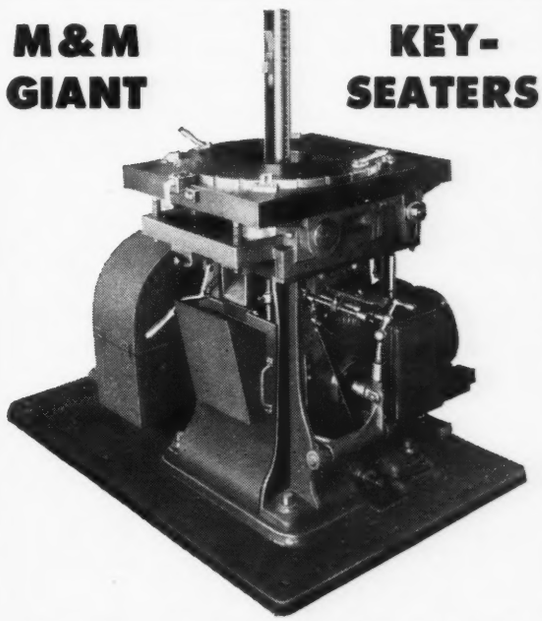
M&M GIANT KEY-SEATERS



Giant Keyseaters, built in various sizes, speedily and accurately cut keyways or splines in pulleys, gears, and other machine parts. Special fixtures and cutters are available for those "hard-to-do" internal finishing operations which cannot be efficiently accomplished otherwise. Send us your problems.

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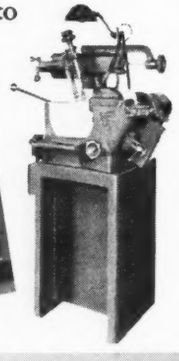
...Make ONE Tap do the work of SIX

Operational tests prove that one tap can be economically reconditioned at least five times on the Blake Flute Grinder, and after each grind the tap will duplicate its original performance. Reductions in tap costs of as much as 75% are reported by users.

Whether you are tapping to class 1 or class 3 tolerances you benefit from the extra life that Blake precision sharpening gives your taps. This method allows you to accurately index the cutting edges and control the rake angles of your taps — reduces breakage and increases effective life six times, and more.

The Blake Flute Grinder has made the sharpening of taps as practical as the sharpening of drills — It will pay you to investigate the money-saving possibilities of this machine.



Write for Bulletin 649M on "How to decrease Tap costs."

EDWARD Blake COMPANY

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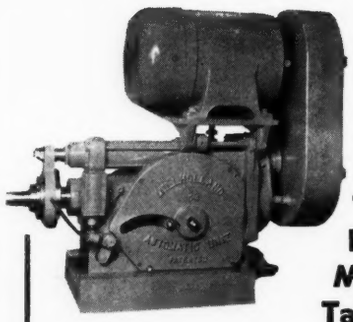
Black Diamond Precision Drill Grinders . . . Blake Tap Chamfer Grinders . . . Blake Flute Grinders . . . Waltham Cutter Sharpeners . . . Waltham Thread Milling Machines . . . American Tool Holders . . . Surface Finish Standards.



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Boring, Drilling, Milling and Tapping Units by

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You can solve the widest range of special machine engineering problems with versatile Millholland Automatic Units. V-belt drive units furnish different speeds through a simple change in sheaves . . . enables one special machine to perform a variety of operations without changing cams or gears . . . also saves space. Geared drive units are designed for machining one part run continuously.

All Millholland Automatic Units feature a special cam which keeps tools cutting 80% to 90% of working time. All use standard foot-type NEMA electric motors. Write for complete information.

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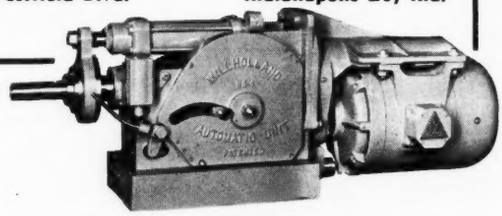

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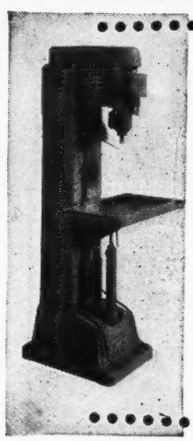

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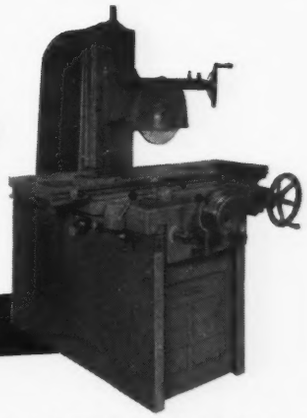
YES...GRINDING HAS COME A LONG WAY SINCE YOU WERE A BOY!

THE NEW 1218

HYDRABRASIVE Surface Grinder



Are you using "boy-at-the-grindstone" methods in your toolroom? If so, why not replace your "old time" surface grinders with the modern 1218 Hydrabrasive — give your toolmakers the machine to make better tools more economically! For production grinding, too, its power, speed, and accuracy cannot be beaten. Hydraulic operation of the No. 1218 is **faster** . . . provides table speeds from 1/2 foot per minute to 90 feet per minute, with 3/8" of cross feed movement in 1/5 of a second! Run-over beyond the work is practically eliminated—the table speed reduces from 90 feet per minute to zero in only 1" of run-over. The No. 1218 is **super-powered.** A 3 HP fan-cooled fully enclosed spindle motor drives the 12" wheel with extra cutting capacity for all work from crush grinding to conventional grinding. You get **wide cross travel** (12") with moderate table length (18") — a deep, massive base, saddle ball ways of hardened steel for precision transverse adjustment, plus many exclusive features that reduce upkeep and cut grinding costs. No matter how you look at it, the No. 1218 is a good buy! For complete information address **Abrasive Machine Tool Co., 12 Dunellen Road, East Providence 14, Rhode Island.** Distributors Throughout the World.

Abrasive Quality is Reflected in the Finish of Your Product

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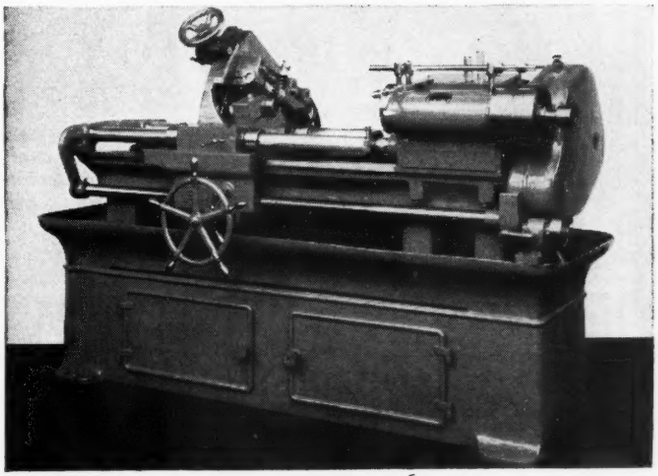
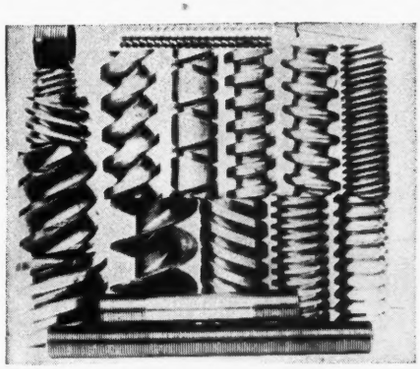
ACCURACY BOOSTS PRODUCTION



Universal Type Cornelis Thread Generator



Cornelis circular cutter cutting worm thread, above, and some typical threads cut on Cornelis machines, at the left.

HIGHER CAPACITY PRECISION PRODUCTION

with the

CORNELIS THREAD GENERATOR

See this fully automatic threading and forming machine in operation at the First United States International Trade Fair in Chicago, anytime from August 7th to 19th, and judge it for yourself. You will be agreeably surprised at its ease of operation, its versatility and the elimination of costly indexing when cutting lead screws and worms of multiple thread.

The Cornelis Thread Generator, product of years of experience, cuts threads by generating, as distinct from thread milling, lathe turning or die chasing. The Cornelis system is indispensable for accurately cutting lead screws and worms of multiple thread, because it requires no indexing. All thread starts are developed at the same time.

Two types of machine are available, a Plain for heavy duty work, and a Universal for normal production. The four bed lengths provided will handle threads up to 18, 37, 77 and 116 inches. Even longer screws can be cut on this **matchless** precision Thread Generator by simply resetting the work.

If you plan to be at the International Trade Fair it may be worth your while to see it in action on stainless steel valve stems. Leon J. Cornelis, of Maison Cornelis of Liege, Belgium, a noted thread cutting authority, will be on hand to demonstrate this equipment at its highest efficiency and to answer your questions.

If you won't be on hand, please drop us a line and we will send you complete engineering details on this machine by return mail.

GEORGE SCHERR CO., INC.
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We Make the

SECONDS COUNT

for **YOU!**

Our method saves you time and labor figured not only in minutes, hours, days or months, but SECONDS AS WELL, through the remarkable speed of

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In fact, you can **DRIVE SCREWS AS FAST AS ONE A SECOND;** a tremendous gain over the old slow hand method—Any kind of screws; machine, wood, brass, self-tapping, sheet metal screws, standard heads, special heads.

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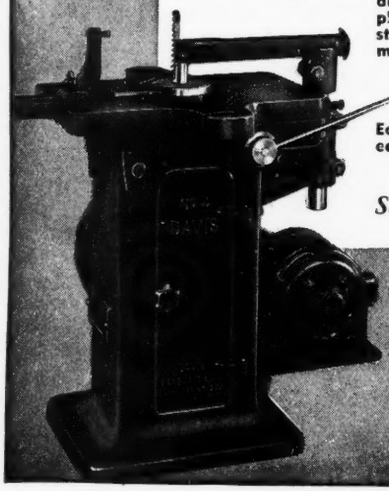
QUICKER Set-up!
QUICKER Cutting!

Davis tilting table with direct-reading scale makes setting up a matter of minutes. Straight work or tapers as much as 3" per foot can be set up. Thin pieces with short bores can be stacked and several cut at once. Cutters for these machines are made in our own plant and carried in stock for quick shipment. Use Davis Keyseaters for job work or long-run production. Equally fast. Equally economical.

Send for bulletin



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No binding, back'ash or inplay. All operating surfaces accurately ground. All joints guaranteed concentric within .0005. Alloy steel for maximum strength. Greater operating angle. Write for literature and prices.

14 Sizes: Diameters 3/8" to 4".
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Canadian Distributors: Irving Smith, Ltd., 455 Craig St., W., Montreal, Canada.
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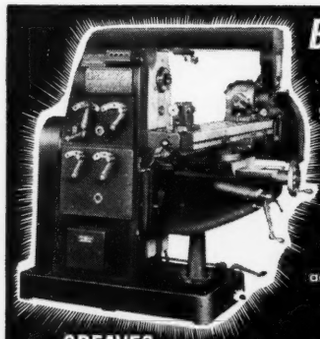

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PLAIN OR UNIVERSAL

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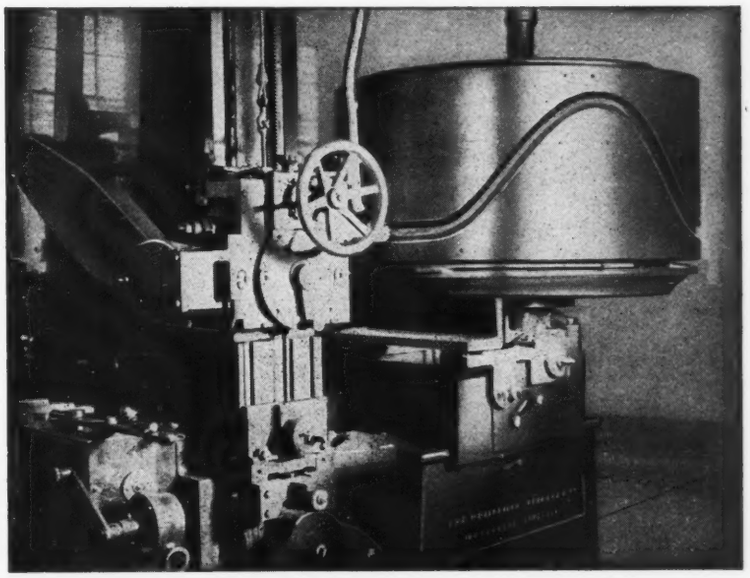
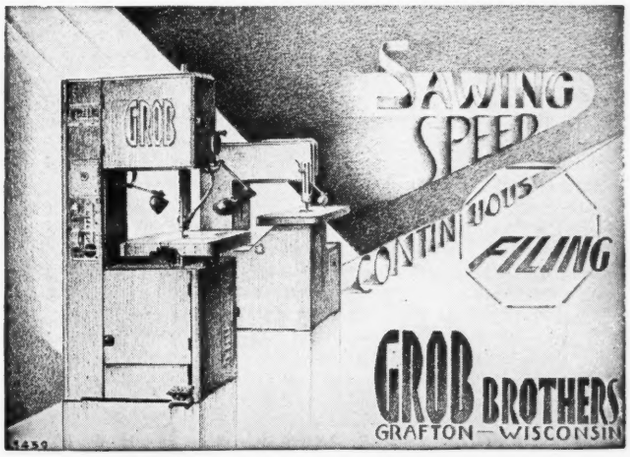
Rowbottom for Cams

Save Valuable Production Time!

Don't waste time! Don't tie up valuable production machines! Use Rowbottom specialist service whenever you need cams. We have the experience and the equipment to produce cams of any size or shape, in any material, for any application. Call on Rowbottom whether you need one big cam such as the one illustrated or a thousand or more smaller ones.



THE ROWBOTTOM MACHINE COMPANY
WATERBURY, CONN., U. S. A.



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ALLIANCE, OHIO

FOR SHARPENING . . .

- Milling cutters
- Gear cutters and reamers

GRAND RAPIDS No. 60
Universal cutter and tool grinder

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- Anti-Friction Bearing Table
- Four Spindle Speeds
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Your letter will bring you complete information and specifications.

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The Braun Gear Company has been shaping the wheels of industry for more than 38 years, producing gears of quality at economical prices. Braun's brand new plant is now more than ever equipped to supply the things that count in gears—precision workmanship, fine materials, good design, and prompt service.

Send samples or prints and specifications for immediate quotations. Whether your requirements are for one gear or thousands, you will find that economy begins with Braun!

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SMALL GEAR AND PINION PRODUCTION THAT'S *Automatic!*

Automatic loading and unloading feature eliminates lost motion in producing accurate small diameter, fine pitch gears and pinions on the Waltham. Individual motor drive through step cone pulleys gives a wide range of feeds and speeds. Compact design takes up less than 4 sq. ft. on the bench. If you want accurate . . . fast . . . economical small gear production, get full information on this and other Waltham automatic machines.

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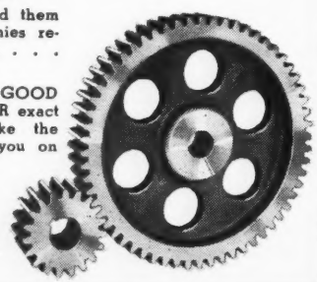
In scores of industries users of CINCINNATI GEARS, GOOD GEARS ONLY, have developed an affectionate respect for their performance, accuracy and longer life.

Ask any user . . . you'll find them enthusiastic about the economies resulting from faster assembly . . . uniformity and effective results.

Each CINCINNATI GEAR, GOOD GEAR ONLY, is made to YOUR exact specifications. We would like the opportunity of working with you on your gear problems.



Spur Sprocket Bevel
Internal Helical *Zerol
***Coniflex Spline Worm**
Spiral Bevel

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"Gears . . . Good Gears Only"
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PRECISION GEARS UP TO 200 DIAMETRAL PITCH

All Gears certified for Accuracy
Quality and Fine Workmanship

NEW JERSEY GEAR & MFG. CO.
1470 Chestnut Ave. **Hillside, N. J.**

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PHILLIE GEAR

makes them all

HYPOIDS, ZEROLS, CURVED TOOTH SPIRAL-BEVELS

These gears assure smoothness, quietness, efficiency, strength and durability.

Teeth of Hypoids are oblique and curved, engaging gradually from one end to the other with continuous contact at pitch line, at least two pairs of teeth always in contact.

Zerol Gears are curved-tooth bevel gears with zero degree spiral angle. They combine localized tooth contact of spiral bevel gears with low thrust loads of straight bevel gears.

Curved Tooth Spiral Bevel gears are unequaled for High Ratio, High Speed Drives where sizes must be kept to a minimum. All are available in sizes up to 48" diameter.

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MEMBER OF AGMA

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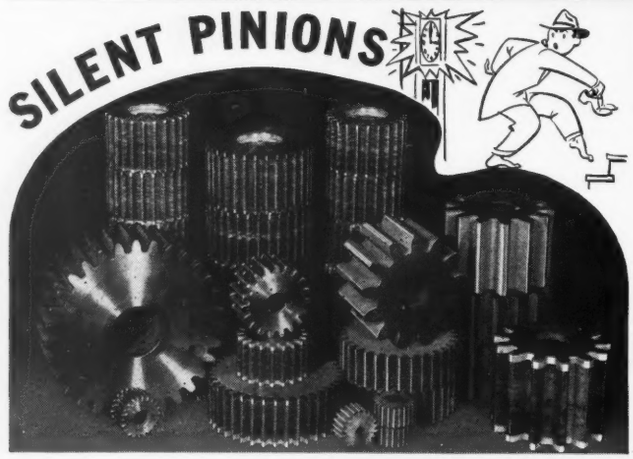
SILENT PINIONS



When your needs call for silent gears and pinions, get them from Stahl. Whether fabroil, bakelite or rawhide, Stahl has the experience and specialized equipment to make them right, in any size or any quantity. For prompt delivery and attractive quotations, get a Stahl estimate first.

SPURS TO 72" PD, 1 DP
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HEAT-TREATED, CASE OR FLAME HARDENED GEARS — OF CARBON OR ALLOY STEEL

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Diefendorf gears are engineered to give top performance and long satisfactory use. Your assurance that any product geared by Diefendorf will stand up well in service. All type gears — all materials.

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DIEFENDORF GEARS

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For circular form tools, designed with top rake, used on "Brown and Sharpe" automatic screw machines, and flat or dove-tail tools used on multiple spindle automatic screw machines. The top rake angles range from 0° to 30°.

The tables also give the amount to grind below center, and give corrections for any basic diameter. They are bound in tough plastic covers and printed on 8½ x 11 inch sheets of 60 pound offset white paper, and contain 119,000 decimals combined with 84 combinations of front angles and top rake angles.

Price: $10.00 postpaid

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COMMERCIAL TOOL HARDENING AND HEAT TREATING

Strictly Modern Equipment, Backed by the Skill and Judgment of 40 years' Experience. Also, We Sell "Heat-Easy" Compound for Pack Hardening High Speed and High Carbon—High Chrome Steels.

THE BENNETT METAL TREATING COMPANY, Elmwood, Conn.

LUERS

PATENTED CUTTING OFF TOOL HOLDERS
PATENTED CUTTING OFF BLADES

ONLY the PATENTED construction of LUERS cutting off BLADES permits normal expansion of bursting chips — MEANS MAXIMUM CUTTING EFFICIENCY.

Manufactured by
J. MILTON LUERS, 12 Pine Street, Mt. Clemens, Mich.
Produced under License Issued by John Milton Luers Patents Inc.

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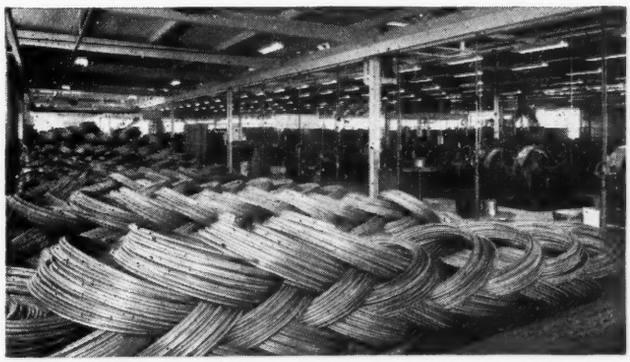


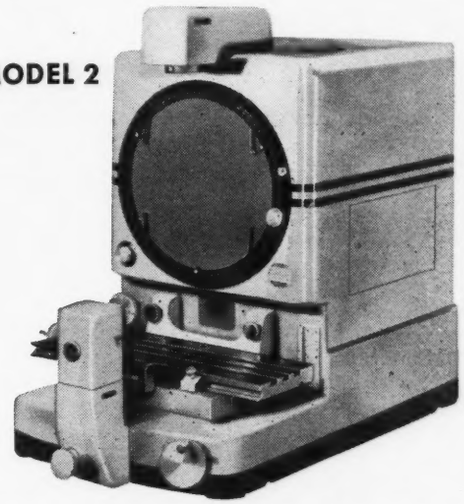
This is a view of some of the wire stocked for cold forging production at Allied Products Corporation. Like all other materials used at Allied, this wire has been carefully selected from top quality sources.

A "close-up" of materials and the many individual operations performed at Allied will prove to you that here your work gets competent attention.

Kodak *Announces the*

KODAK CONTOUR PROJECTOR

MODEL 2



the most versatile optical comparator you can buy

It handles large parts. There's 6¾ inches from lamp house to object and 8 inches from object to lens—*at all magnifications.* Front lamp house pivots to make room for long objects under surface illumination. Vertical travel is 4 inches.

It gives surface illumination in any of 5 planes, and switches instantly from surface illumination to silhouette projection, or to a combination of both. Instant dialing to any of 6 magnifications from 10× to 100× without distortion. The 14-inch screen is extra bright; no hoods or curtains needed —even in fully lighted rooms. Designed for all-day operator comfort, yet built to precise toolroom standards.

We'd like to show you how it can handle your own inspection problems.

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Industrial Optical Sales Division
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the KODAK CONTOUR PROJECTOR
SHOWS contours, of course
surface details...
deep, blind holes

Kodak

LOOK FOR THE NAME
VIKING
On Your Pump

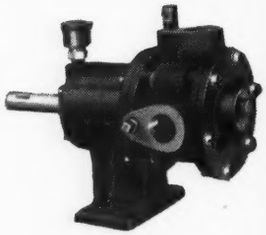

Fig. 76

And You Know It's GENUINE

The job of building the original "gear within a gear" rotary pump has been the single aim of the Viking Pump Company for over 39 years.

Developments and improvements have steadily progressed with this single purpose in mind . . . the advancement of this most copied of all rotary pump principles.

It's the self priming pump with a steady and sure delivery of all types of clean liquids regardless of viscosity, and in capacities from ½ to 1050 gpm.

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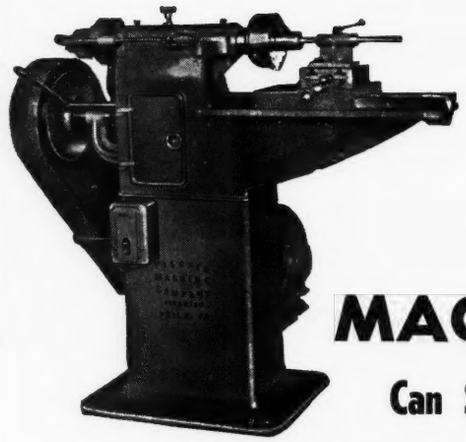
See Our Catalog in SWEETS

Viking Pump Company
Cedar Falls, Iowa



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Used by all the leading bushing manufacturers

The Fischer Oil Groover cuts straight or spiral grooves on either bearings or shafts. It can be quickly set up to cut almost any type of groove. Simple design reduces maintenance; rugged construction permits taking of heavy cuts up to 8" in length or 15" on the larger model. Let us show you how to simplify all your oil grooving problems with Fischer equipment. Send us samples of your work. We will groove it according to your specifications and return it with production figures. No obligation, of course.

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ESTABLISHED 1900

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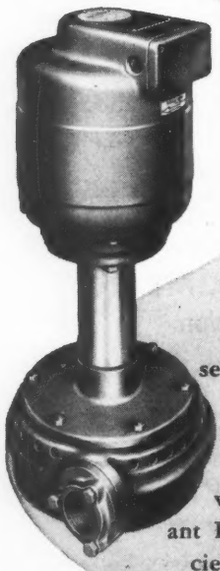
RUTHMAN GUSHER
MACHINE TOOL COOLANT PUMPS



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makes precision "milled from the bar" screw machine products that stand up under hard usage . . . and whose uniformity and fine finish save assembly time and maintenance costs.

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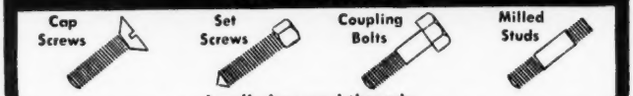

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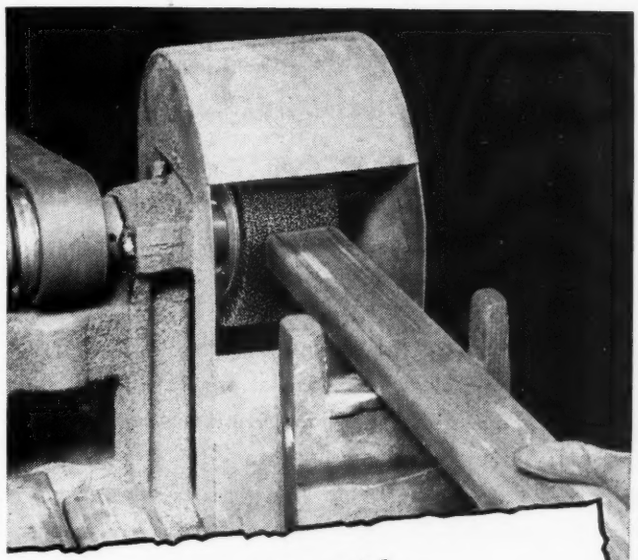

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with J & S KOALA
CIRCULAR CUTTING TOOLS

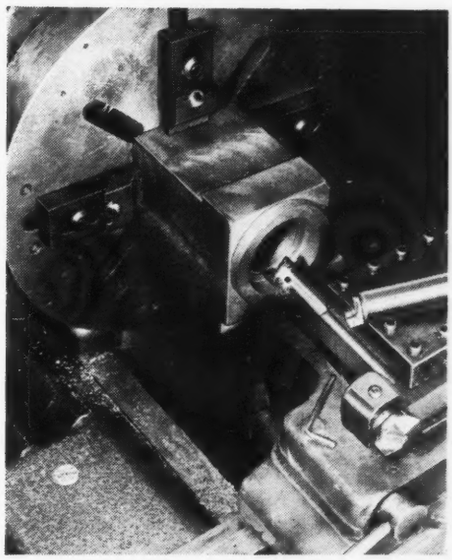

Photo shows typical deep boring, boring and internal facing operation for bearing seat, and external facing and turning. The 12" J & S KOALA Boring Bar is removed from turret to show carbide head after numerous re-grinds.

With these J & S Time Savers—available in carbide or high speed steel, at reasonable prices—each new or re-sharpened cutter can be inserted without resetting machine or stops in any way! This is possible because each cutter accurately repeats the original set-up position when it is inserted into the shank. Removing and inserting is quick and simple. Different types of cutters can be used in the same shank. J & S KOALA TOOLS are easy to re-grind with any desired rake. Cutters may be re-ground without a jig. It is **not** necessary to re-grind any predetermined amount off the rake surface. With KOALA TOOLS, the **same** tool can be used for turning and facing—the **same** shank may be used for forming, necking and grooving—and the **same** internal tool can be used for internal facing or boring.

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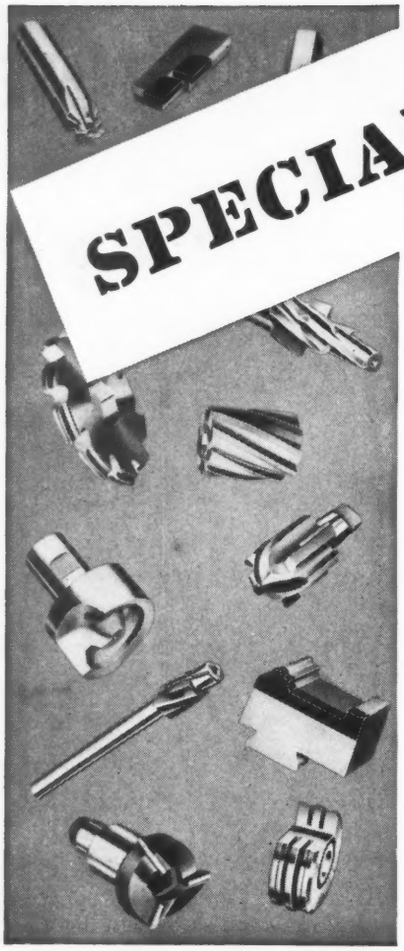
External Turning Tools: Turning, Facing, Forming, Threading

Write for Further Information

SEND FOR BOOKLET

"Machine Shop TIME SAVERS by J & S". Illustrates and explains: J & S "Fluid-motion" Dressers, KOALA Circular Cutting Tools, "Down-Hold" Vise Jaws and "Attachable" Parallels, "All-Purpose" Jaw Clamps, and J & S Form Grinding Service.

J&S TOOL CO., INC.
470 Main Street, East Orange, N. J.
Representatives in Principal Cities



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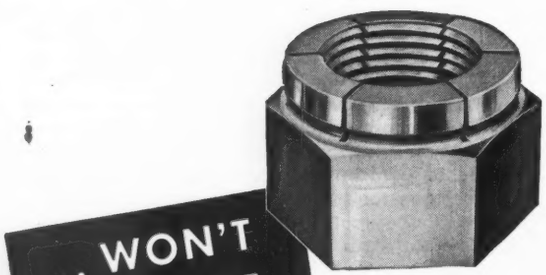

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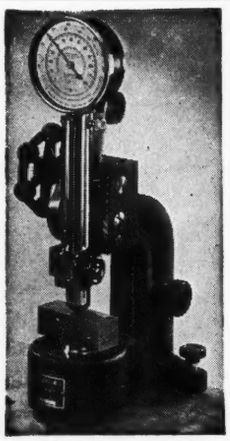

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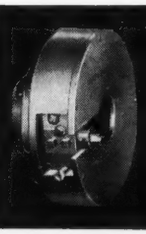

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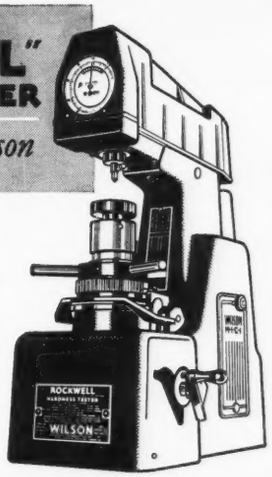

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No. 16—38" Bryant, m.d., latest
No. 9 Cincinnati, belt
No. 6, 10, 20 Bryant, belt
No. 24—21" Bryant, m.d., late
No. 24—36" Bryant, m.d., latest
No. 49 Heald Single End Borematic, m.d.
No. 70 Heald, belt
No. 72A Heald Plain, m.d.
No. 72A Heald Gagematic, m.d.
No. 72A3 Heald Sizematic, m.d.
No. 72A3 Heald Gagematic, m.d.
No. 72A5 Heald Sizematic, m.d.
No. 72A5 Heald Plain, m.d.
No. 72A5 Heald Plain, long bed type, m.d., latest
No. 73 Heald, m.d., brand new, latest
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No. 174 Heald Gap, m.d., latest
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Series 5—No. 5 Bryant, m.d., latest

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CT-36 Lees-Bradner, m.d., latest
CT-54 Lees-Bradner, m.d., latest
Hall Planetary, m.d.
4½x12", 6x14", 6x20", 6x48", 6x80" Pratt & Whitney
10x24" Hanson-Whitney, m.d., latest
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No. 1M Cincinnati, m.d.
No. 1 Special Plain Kearney & Trecker Milwaukee, m.d.
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No. 2B Brown & Sharpe, m.d., latest
No. 2 Cincinnati H.S. Dial, m.d., latest
No. 2 Rockford, m.d.
No. 3 Standard Cincinnati, m.d.
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No. 3 Van Norman Duplex, s.p.d.
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No. 4 Cincinnati H.P., m.d.
No. 5 Cincinnati, rect. overarm, m.d.
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No. 3, 4 Cincinnati H.P., m.d.
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No. 2K, 3K, 4K Milwaukee Dial, m.d., latest
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No. 5 Brown & Sharpe, cone
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30"x30"x10' Gray, 2 heads, belt
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36"x36"x10' Niles, 2 heads, belt
36"x36"x18' Niles-Bement-Pond, 2 heads, reversing m.d.
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Classified and Re-Sale Section

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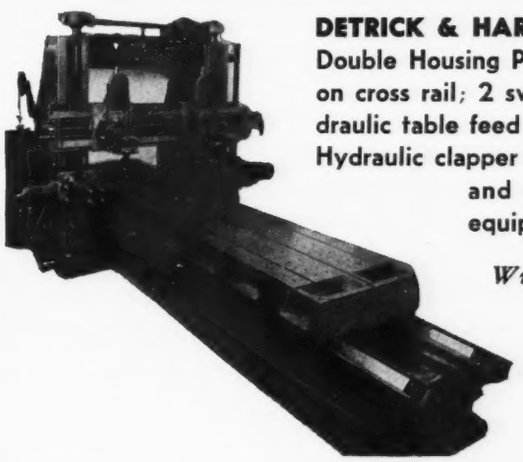

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For addresses of manufacturers listed, consult advertisements in this and previous issue. *Index Pages 343-344*

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Walls Sales Corp.

ABRASIVE DISCS
See Discs, Abrasive.

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Hydropress Inc.
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Morgan Engineering Co.
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AIR TOOLS—See Grinders, Pneumatic; Drills, Portable Pneumatic, etc.

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National-Erie Corp.
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Ryerson, Joseph T., & Son, Inc.
U. S. Steel Corp., Carnegie-Illinois Steel Corp. Div.
Vanadium-Alloys Steel Co.
Wheelock, Lovejoy & Co., Inc.

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Aluminum Co. of America

ALLOYS, Non-Ferrous
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Bridgeport Brass Co.
Revere Copper & Brass Inc.

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See Presses, Arbor.

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Ryerson, Joseph T., & Son, Inc.

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Pope Machinery Corp.
Sundstrand Mch. Tool Co.
Westinghouse Electric Corp.

BALLS
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S K F Industries, Inc.

BARS, Boring
See Boring Bars.

BARS, Phosphor Bronze
Bunting Brass & Bronze Co.
Johnson Bronze Co.

BARS, Steel
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Bethlehem Steel Co.
Carpenter Steel Co.
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Frasse, Peter A., & Co., Inc.
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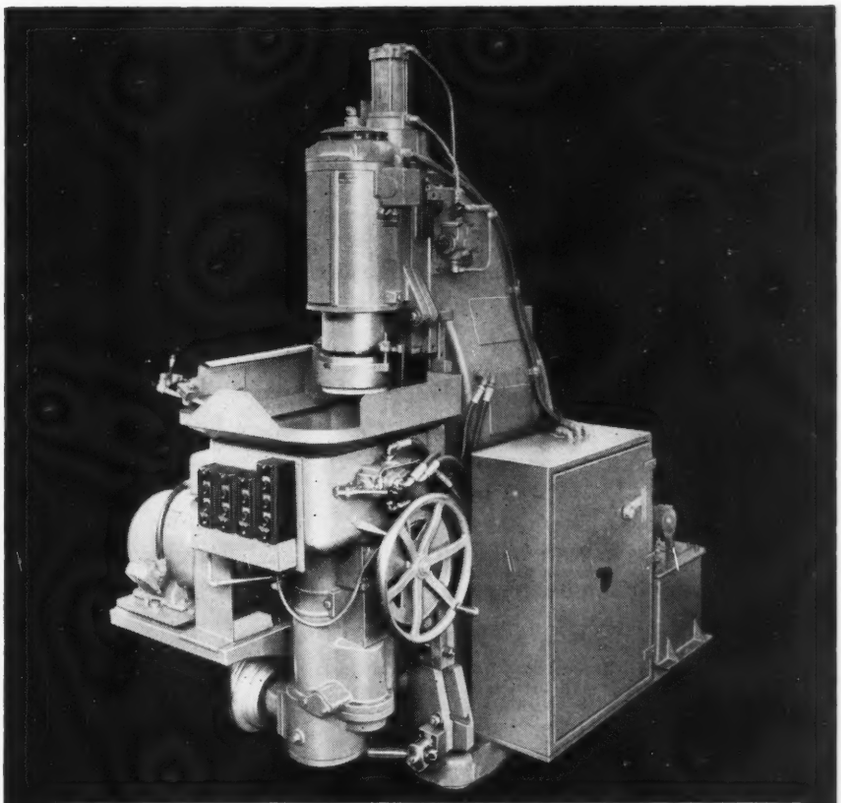

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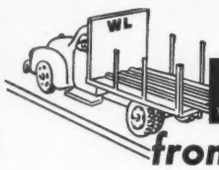

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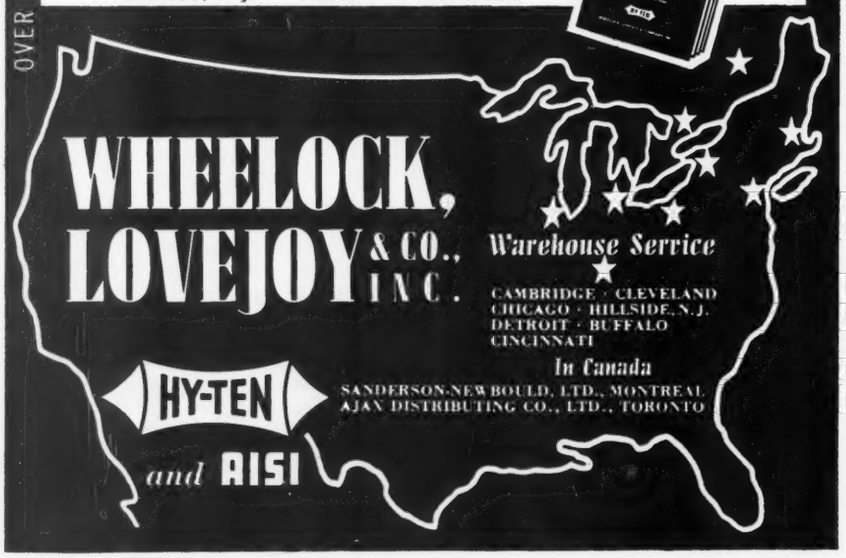

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NOTE: Machine is now made available to more production within its capacity.

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Hobbing of the worm is performed on a Barber Colman No. 16-16 gear hobbing machine in one pass.

MULTI-PURPOSE CUTTING FLUID SAVES ON MACHINING WORM GEARS

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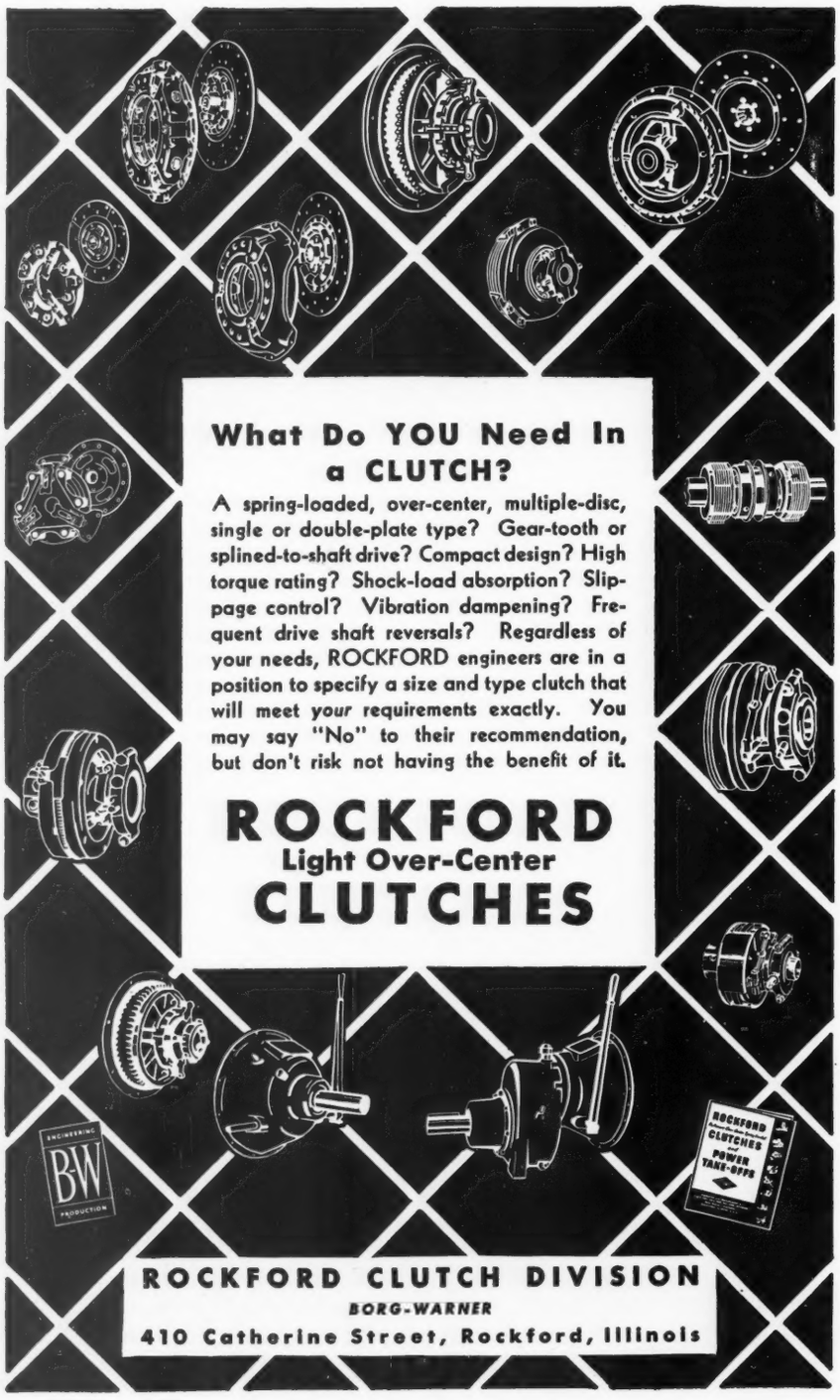
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Bethlehem Steel Co.
Brown & Sharpe Mfg. Co.
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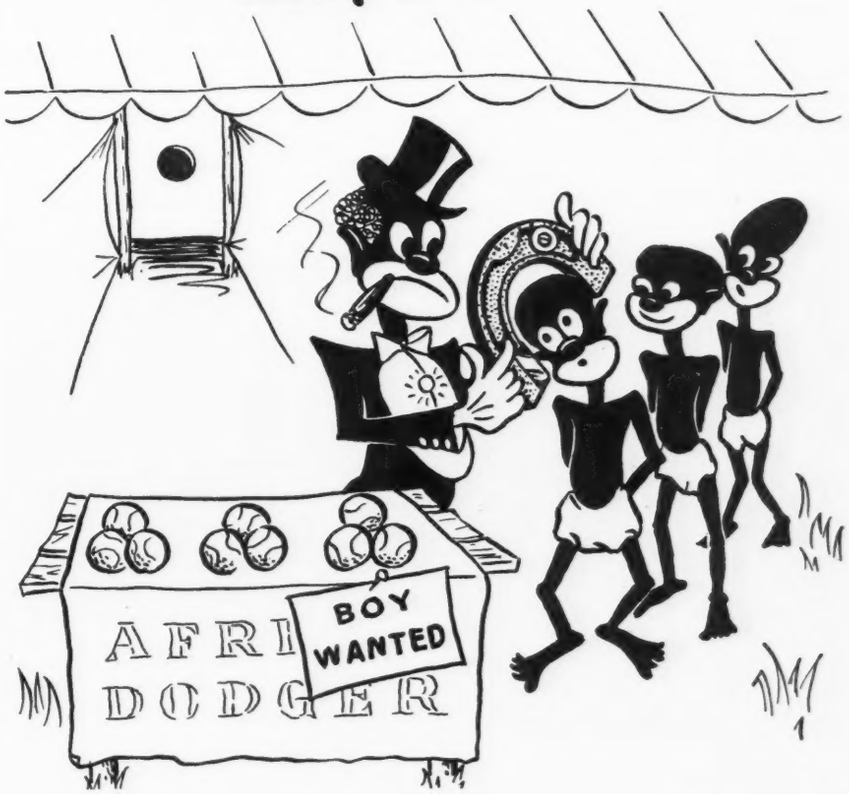

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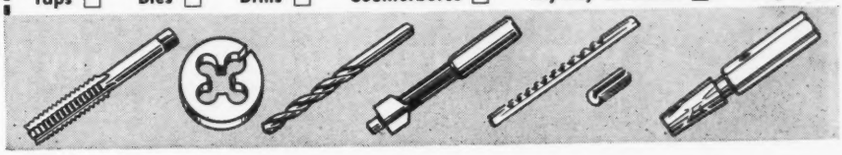

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Murchey Div., Sheffield Corp.
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Seneca Falls Mch. Co.
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See Collets.

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Ettco Tool Co.
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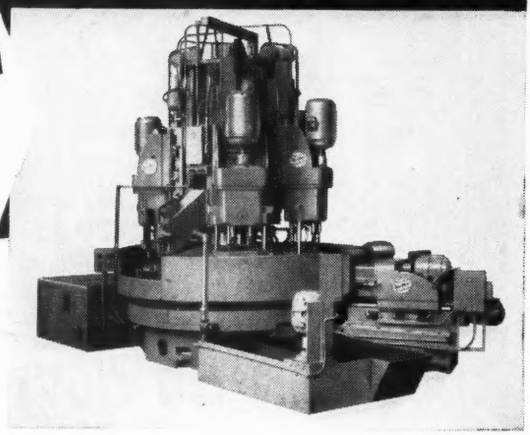

Here's a good example of the application of standard machine units to a special production job. Drilling and reaming operations of suspension support holes are performed on both right-hand and left-hand parts simultaneously. Drilling and reaming king pin holes is also included. Six stations, five operating and one loading, handle all operations with a total of 16 spindles. Machines of this type can be furnished from standard basic units for special applications on most all metalworking operations.

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This machine is a good representative of the applications of D. & T. Roto-matic mechanical power heads. Six heads are used, three vertical and three horizontal. These new power heads lower maintenance costs through elimination of excessive servicing.

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Rockford Clutch Div.
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COLLARS, Safety
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Pratt & Whitney
Standard Tool Co.
Tomkins-Johnson Co.
Union Twist Drill Co.
Universal Engineering Co.
Warner & Swasey Co.

COMPARATORS
See Gages, Comparator.

COMPARATORS, Optical
Jones & Lamson Mch. Co.
Scherr, George, Co., Inc.

COMPOUNDS, Cleaning
Oakite Products, Inc.

COMPOUNDS, Cutting, Grinding, Metal Drawing, Etc.
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National Broach & Mch. Co. (Broaching and Lapping)
Oakite Products, Inc.
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Stuart, D. A., Oil Co., Ltd.
Sun Oil Co.
Texas Co.
Tide Water Associated Oil Co.

COMPOUNDS, Resin and Molding
Bakelite Div., Union Carbide & Carbon Corp.
General Electric Co.

COMPRESSORS, Air
Chicago Pneumatic Tool Co.

CONTRACT WORK
Arter Grinding Machine Co.
Blanchard Mch. Co.
Columbus Die, Tool & Mch. Co.
Diefendorf Gear Corp.
Ex-Cell-O Corp.
Fellows Gear Shaper Co.
Hartford Special Mchry. Co.
Hill Acme Co.
Sheffield Corp.
Morse Twist Drill & Machine Co.
Mummert-Dixon Co.
National Acme Co.
Rockford Machine Tool Co.
Taft-Peirce Mfg. Co.
U. S. Tool Co., Inc.
Wicaco Machine Corp.

CONTROLLERS
Allen-Bradley Co.
Bristol Co.
General Electric Co.
Westinghouse Electric Corp.

COUNTERBORES
Allen Mfg. Co.
Carboloy Co., Inc.
Cleveland Twist Drill Co.
Continental Tool Works Div.
Ex-Cell-O Corporation
Gairing Tool Co.
Kennametal, Inc.
National Tool Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Starrett, The L. S., Co.
Threadwell Tap & Die Co.
Union Twist Drill Co.

COUNTERSHAFTS
Standard Pressed Steel Co.

COUNTERSINKS
Cleveland Twist Drill Co.
Ex-Cell-O Corp.
Gairing Tool Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Standard Tool Co.
Union Twist Drill Co.

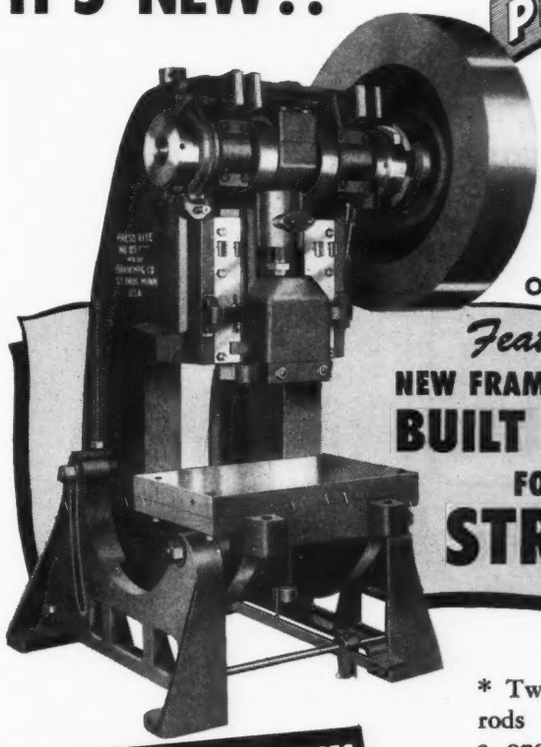
COUNTERS, Revolution
Bristol Co.
Brown & Sharpe Mfg. Co.
Starrett, The L. S., Co.
Veeder-Root Inc.

COUNTING DEVICES
Starrett, The L. S., Co.
Veeder-Root Inc.

COUPLINGS, Flexible
Boston Gear Works, Inc.
Farrel-Birmingham Co., Inc.
Lovejoy Flexible Coupling Co.
Philadelphia Gear Works
Westinghouse Electric Corp.

IT'S NEW!!

PRESS-RITE
85 TON POWER PRESS
OPEN BACK • INCLINABLE



Featuring . . .
NEW FRAME DESIGN* WITH
BUILT IN TIE RODS
FOR GREATER
STRENGTH

PRESS-RITE POWER PRESSES ARE BUILT IN SIZES FROM 5 TO 85 TON!

* Two high tensile steel tie rods heated and shrunk into a one-piece gap frame. This frame cast in our own foundry of special alloy. The tie rods reinforce frame at back of gap to over twice the capacity of the press . . . extra strength, rigidity and insured extra tonnage . . . at NO EXTRA COST!

NEW FRAME DESIGN — Exclusive on Press-Rite Power Presses.

DON'T DELAY . . . Investigate this new feature and the new 85 ton Press-Rite Press today. It may be the solution to your power press problem.

SEE THE PRESS-RITE line at your dealer.

. . . WRITE FOR COMPLETE DETAILS NOW!

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Sales Service Machine Tool Co.
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ST. PAUL 4, MINNESOTA

Ask your **VICTOR** *distributor about*

THE NEW *molyflex* HIGH SPEED HAND HACK SAW BLADES

Your Victor distributor will tell you that this new "Molyflex"... when pitted against eight leading competitive blades in cutting treated SAE 52100 ball bearing steel . . . *averaged 23.8% more metal cut* than all the leading brands tested. He will tell you that this new "Molyflex" . . . an addition to the Victor line . . . has greater uniformity, is absolutely shatterproof and unbreakable when used in a frame.

VICTOR STEELRITE METAL MARKING CRAYONS

Ask your Victor distributor about the new Victor Steelrite Metal Marking Crayons. Available in a variety of sizes, these crayons are made of genuine soapstone. Special extrusion process insures uniform strength and composition. Markings can be made on hot, cold, damp or grimy metal and withstand pickling, yet do not affect enamel application.

Don't forget to ask for a free copy of the Victor Metal Cutting Booklet for your pocket or tool kit and the Victor Wall Chart for your shop. They'll help you get the maximum efficiency from your metal cutting saw blades.

VICTOR
SAW WORKS, INC., Middletown, N. Y., U. S. A.
Makers of Hand and Power Hack Saw Blades, Frames and Band Saw Blades

COUPLINGS, Shaft
Boston Gear Works, Inc.
Hilliard Corp.
Standard Pressed Steel Co.

CRANES, Electric Traveling
Cleveland Crane & Engrg. Co.
Morgan Engineering Co.
Shepard Niles Crane & Hoist Corp.

CRANES, Hand Traveling
Shepard Niles Crane & Hoist Corp.

CRANES, Locomotive
Cullen-Friestedt Co.

CUTTER GRINDERS
See Grinding Machines, Universal, for Sharpening Cutters, Reamers, Hobs, Etc.

CUTTERS, Gear
Brown & Sharpe Mfg. Co.
Ex-Cell-O Corp.
Fellows Gear Shaper Co.
Morse Twist Drill & Machine Co.
National Broach & Mch. Co. (Shaving)
National Tool Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Union Twist Drill Co.
Waltham Machine Works

CUTTERS, Keyseater
Davis Keyseater Co.
du Mont Corp.
Keo Cutters
Threadwell Tap & Die Co.

CUTTERS, Milling
Barber-Colman Co.
Brown & Sharpe Mfg. Co.
Carboloy Co., Inc.
Cleveland Twist Drill Co.
Continental Tool Wks., Div., Ex-Cell-O Corp.
Ex-Cell-O Corp.
Gairing Tool Co.
Gorham Tool Co.
Gorton, George, Machine Co.
Hanson-Whitney Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Kennametal, Inc.
Lovejoy Tool Co., Inc.
Morse Twist Drill & Machine Co.
National Tool Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Tomkins-Johnson Co.
Union Twist Drill Co.

CUTTING COMPOUNDS
See Compounds, Cutting, Grinding, Etc.

CUTTING AND GRINDING FLUIDS
Cincinnati Milling Products Div., Cincinnati Milling Machine Co.
Cities Service Oil Co.
Gulf Oil Corp.
Sinclair Refining Co.
Stuart, D. A., Oil Co., Ltd.
Sun Oil Co.
Texas Co.
Tide Water Associated Oil Co.

CUTTING-OFF MACHINES
Bardons & Oliver, Inc.
Bridgeport Safety Emery Wheel Co.
Brown & Sharpe Mfg. Co.
Cone Automatic Mch. Co. (Lathe Type)
Consolidated Mch. Tool Corp.
DoAll Co.
Landis Machine Co. (Pipe)

CUTTING-OFF MACHINES, Abrasive Wheel
Campbell Machine Div., American Chain & Cable

CUTTING-OFF MACHINES, Cold Saw
See Sawing Machines, Circular.

CUTTING-OFF MACHINES, Metal Band Saws
Armstrong-Blum Mfg. Co.
Grob Bros.

CUTTING-OFF TOOLS
Allegheny Ludlum Steel Corp.
Armstrong Brothers Tool Co.
Kennametal, Inc.
Luers, J. Milton
Pratt & Whitney
Vanadium-Alloys Steel Co.
Williams, J. H., & Co.

CUTTING-OFF WHEELS, Abrasive
Carborundum Co.
Norton Co.
Raybestos-Manhattan, Inc., Manhattan Rubber Div.

CYLINDER BORING MACHINES
Baker Brothers, Inc.
Barnes Drill Co.
Consolidated Mch. Tool Corp.
Cross Co.
Ex-Cell-O Corp.
Ingersoll Milling Mch. Co.
Moline Tool Co.

CYLINDERS, Hydraulic
American Hollow Boring Co.
Barnes, John S., Corp.
Hannifin Corp.
Logansport Machine Co., Inc.
Oilgear Co.
Rockford Machine Tool Co.
Tomkins-Johnson Co.

CYLINDERS, Pneumatic
Hannifin Corp.
Tomkins-Johnson Co.

DEALERS, Machinery
Botwinik Brothers of Mass., Inc.
Earle Gear & Machine Co.
Motch & Merryweather Mchry. Co.
Ryerson, Joseph T., & Son, Inc.
Simmons Machine Tool Corp.

DEMAGNETIZERS
Blanchard Mch. Co.
Heald Machine Co.
Walker, O. S., Co., Inc.

DESIGNERS, Machine and Tool
Ex-Cell-O Corp.
Hartford Special Mchry. Co.
Pratt & Whitney
Sundstrand Machine Tool Co.

DIE-CASTING MACHINES
Hydropress, Inc.

DIE-CASTING
See Castings, Die.

DIE CUSHIONS
Bliss, E. W., Co.
Clearing Mch. Corp.
Dayton Rogers Manufacturing Co.
Verson Allsteel Press Co.

DIE INSERTS, Carbide
Allegheny Ludlum Steel Corp.
Carboloy Co., Inc.
Kennametal, Inc.
Metal Carbides Corp.

For more information on products advertised, use Inquiry Card, Page 225

DIE MAKERS' SUPPLIES
Allied Products Corp.
Baumbach, E. A., Mfg. Co.
Danly Mch. Specialties, Inc.
U. S. Tool Company, Inc.

DIE MAKING MACHINES
Grob Brothers
Kearney & Trecker Corp.
Oliver Instrument Co.

DIE SETS, Standard
Baumbach, E. A., Mfg. Co.
Danly Mch. Specialties, Inc.
Pratt & Whitney

DIE SINKING MACHINES
Cincinnati Milling Mch. Co.
Elmes Engineering Div., American Steel Foundries
Gorton, George, Machine Co.
Pratt & Whitney

DIE SINKING PRESSES
Baldwin Locomotive Works
Kearney & Trecker Corp.

DIE STOCKS
See Stocks, Die.

DIES, Sheet Metal, Etc.
Allied Products Corp.
Baumbach, E. A., Mfg. Co.
Bliss, E. W., Co.
Carboloy Co.
Columbus Die, Tool & Mch. Co.
Metal Carbides Corp.
Niagara Mch. & Tool Works
Taft-Peirce Mfg. Co.
V&O Press Co., Div. Rockwell Mfg. Co.
Verson Allsteel Press Co.
Wales-Strippit Corp.
Waltham Machine Works
Whistler, S. B., & Sons, Inc.

DIES, Threading
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Eastern Mch. Screw Corp.
Geometric Tool Co.
Greenfield Tap & Die Corp.
Hill Acme Co.
Morse Twist Drill & Machine Co.
Murchey Div., Sheffield Corp.
National Acme Co.
Pratt & Whitney
Standard Tool Co.
Threadwell Tap & Die Co.
Winter Bros. Co.

DIES, Threading, Opening
Eastern Mch. Screw Corp.
Errington Mechanical Laboratory
Geometric Tool Co.
Hill Acme Co.
Jones & Lamson Mch. Co.
Landis Mch. Co.
Murchey Div., Sheffield Corp.
National Acme Co.
Sheffield Corp.

DIES, Thread Rolling
Pratt & Whitney

DISCS, Abrasive
Besly, Chas. H., & Co.
Carborundum Co.
Gardner Machine Co.
Norton Co.
Raybestos-Manhattan, Inc., Manhattan Rubber Div.
Simonds Abrasive Co.
Walls Sales Corp.

DIVIDING HEADS
See Index Centers.

DOWEL PINS
Allen Mfg. Co.
Baumbach, E. A., Mfg. Co.
Danly Mch. Specialties, Inc.
U. S. Tool Co., Inc.

DRESSERS, Grinding Wheel
Carboloy Co., Inc.
J & S Tool Co.
Metal Carbides Corp.
Norton Co.
Standard Tool Co.

DRIFTS, Drill
Armstrong Bros. Tool Co.
Commander Mfg. Co.
Standard Tool Co.

DRILL HEADS, Multiple Spindle
Baker Brothers, Inc.
Barnes Drill Co.
Buffalo Forge Co.
Errington Mechanical Laboratory
Ettco Tool Co.
Ex-Cell-O Corp.
Moline Tool Co.
United States Drill Head Co.

DRILL HEADS, Unit Type
Barnes Drill Co.
Kingsbury Mch. Tool Corp.
Rehnberg-Jacobson Mfg. Co.
Snow Mfg. Co.

PRECISION
SURFACE PLATES

FOR LAYOUT, INSPECTION, ASSEMBLY

Available either precision ground or planer finished, Challenge Layout Surface Plates offer a perfectly smooth, square surface for layout, inspection or assembly line operations. Sizes range from 12"x18" to 54"x144". All are built of special analysis semi-steel.

The all-steel stand is arc-welded to furnish the rigidity of a one-piece unit. Special leveling screws enable the user to level the plate quickly and to lock it securely.

Standard plate thickness is 6". Thickness of 8", as well as special sizes, grooving, scoring, machining and slotting may be had to order. On special order, plates may be keyed so that two or more may be assembled into one complete unit.

For specifications, plus information on other Challenge equipment for the tool and machine industries, write today. 632

SURFACE PLATE EQUIPMENT
UNIVERSAL IRONS
Four Sizes to 6x10x5-1/2"
ANGLE PLATES
22 Sizes to 24x24x24"
BOX PARALLELS
18 Sizes to 12x12x24"
V-BLOCKS
Seven Sizes to 12x12x12"

THE CHALLENGE MACHINERY CO.
GRAND HAVEN, MICHIGAN

don't scrap metal by turning!

...save by Swaging

on

TORRINGTON SWAGERS

The Torrington Rotary Swaging Machine uses every bit of stock. With 4000 hammer blows a minute, swaging reduces, sizes, rounds, tapers and points rod, wire and tubing. It makes metal tougher and more resilient. It hammers away minor surface defects.

Torrington Swagers are built to a mechanical perfection based on our 42 years' swaging experience. Send today for your free copy of the illustrated booklet describing the machine and the method.

THE TORRINGTON COMPANY
Swager Department
558 Field Street • Torrington, Conn.

Send the coupon today for your free copy of this booklet.

Please send a copy of "The Torrington Swaging Machine" to:

Name_____

Firm_____

Address_____ 8

DRILL SOCKETS
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Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Union Twist Drill Co.

DRILL STANDS
Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Union Twist Drill Co.
Standard Tool Co.

DRILLING MACHINES, Automatic
Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F. & John, Co.
Bodine Corp.
Consolidated Mch. Tool Corp.
Hartford Special Machinery Co.
Kingsbury Mch. Tool Corp.
Millholland, W. K., Machinery Co.
National Automatic Tool Co.
Snow Mfg. Co.

DRILLING MACHINES, Bench
Buffalo Forge Co.
Fosdick Mch. Tool Co.
Henry & Wright Div. of Hartford-Empire Co.
Leland-Gifford Co.
Walker-Turner Div., Kearney & Trecker Corp.

DRILLING MACHINES, Boiler
Cincinnati Bickford Tool Co.
Foote-Burt Co.

DRILLING MACHINES, Deep Hole
Pratt & Whitney
Leland-Gifford Co.
National Automatic Tool Co.

DRILLING MACHINES, Gang
Baker Brothers, Inc.
Barnes Drill Co.
Cincinnati Bickford Tool Co.
Consolidated Mch. Tool Corp.
Foote-Burt Co.
Fosdick Mch. Tool Co.
Ingersoll Milling Mch. Co.
Leland-Gifford Co.
Millholland, W. K., Machinery Co.
Moline Tool Co.
National Automatic Tool Co.

DRILLING MACHINES, Horizontal Duplex
Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F. & John, Co.
Consolidated Mch. Tool Corp.
Davis & Thompson Co.
Kingsbury Mch. Tool Corp.
Millholland, W. K., Machinery Co.
Moline Tool Co.
Murchey Div., Sheffield Corp.
National Automatic Tool Co.
Snow Mfg. Co.
Sundstrand Mch. Tool Co.

DRILLING MACHINES, HORIZONTAL Portable
Cincinnati Bickford Tool Co.

DRILLING MACHINES, Inverted
Baker Brothers, Inc.
Barnes Drill Co.
National Automatic Tool Co.

DRILLING MACHINES, Multiple Center Column Type
Barnes Drill Co.
National Automatic Tool Co.

DRILLING MACHINES, Multiple Spindle
Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F. & John, Co.
Buffalo Forge Co.
Cincinnati Bickford Tool Co.
Cross Co.
Davis & Thompson Co.
Fosdick Mch. Tool Co.
Greenlee Bros. & Co.
Hartford Special Machinery Co.
Henry & Wright Div. of Hartford-Empire Co.
Ingersoll Milling Mch. Co.
Kingsbury Mch. Tool Corp.
Leland-Gifford Co.
Millholland, W. K., Machinery Co.
National Automatic Tool Co.
Moline Tool Co.
Pratt & Whitney
Snow Mfg. Co.
Taylor & Fenn Co.

DRILLING MACHINES, Radial
American Tool Works Co.
Carlton Machine Tool Co.
Cincinnati Bickford Tool Co.
Foote-Burt Co.
Fosdick Mch. Tool Co.

DRILLING MACHINES, Rail
See Drilling Machines, Gang.

DRILLING MACHINES, Sensitive
Buffalo Forge Co.
Foote-Burt Co.
Fosdick Mch. Tool Co.
Henry & Wright Div. of Hartford-Empire Co.
Leland-Gifford Co.
National Automatic Tool Co.
Pratt & Whitney
Ryerson, Joseph T., & Son, Inc.
Snow Mfg. Co.
Taylor & Fenn Co.

DRILLING MACHINES, Upright
Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F. & John, Co.
Buffalo Forge Co.
Cincinnati Bickford Tool Co.
Consolidated Mch. Tool Corp.
Ex-Cell-O Corp.
Foote-Burt Co.
Fosdick Mch. Tool Co.
Hartford Special Machinery Co.
Ingersoll Milling Mch. Co.
Kingsbury Mch. Tool Corp.
Leland-Gifford Co.
Moline Tool Co.
National Automatic Tool Co.
Rehnberg-Jacobson Mfg. Co.
Rogers Machine Works, Inc.
Ryerson, Joseph T., & Son, Inc.
Snow Mfg. Co.

DRILLING MACHINES, Wall Radial
Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.

DRILLS, Center
Cleveland Twist Drill Co.
Gairing Tool Co.

For more information on products advertised, use Inquiry Card, Page 225

Greenfield Tap & Die Corp.
Keo Cutters
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Standard Tool Co.
Union Twist Drill Co.
Warner & Swasey Co.

DRILLS, Core
Carboloy Co., Inc.
Ex-Cell-O Corp.
Gairing Tool Co.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Standard Tool Co.
Union Twist Drill Co.

DRILLS, Deep Hole
Pratt & Whitney
Union Twist Drill Co.

DRILLS, Portable Electric
Chicago Pneumatic Tool Co.
Ryerson, Joseph T., & Son, Inc.

DRILLS, Portable Pneumatic
Chicago Pneumatic Tool Co.

DRILLS, Ratchet
Armstrong Bros. Tool Co.
Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Union Twist Drill Co.

DRILLS, Twist
Ampco Twist Drill Div., Greenfield Tap & Die Corp.
Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Union Twist Drill Co

DRILLS, Wire
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Standard Tool Co.
Union Twist Drill Co.

DUPLICATORS
Gorton, George, Machine Co.
Pratt & Whitney
Rockford Machine Tool Co.

DUST CONTROL SYSTEMS
Pangborn Corp.

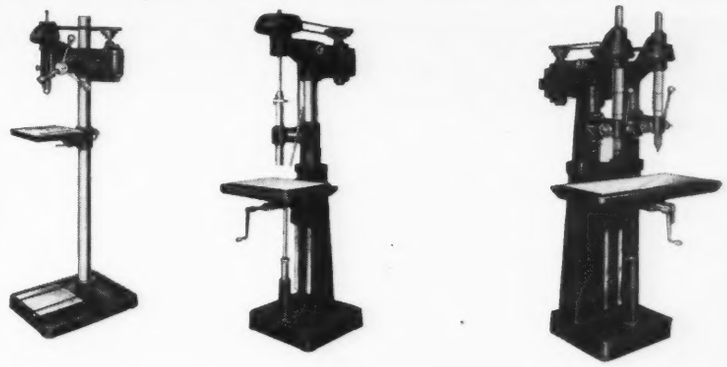
ELECTRICAL EQUIPMENT
General Electric Co.
Westinghouse Electric Corp.

EMERY WHEELS
See Grinding Wheels.

EMERY WHEEL DRESSERS
See Dressers, Grinding Wheel.

ENGRAVING MACHINES
Gorton, George, Machine Co.

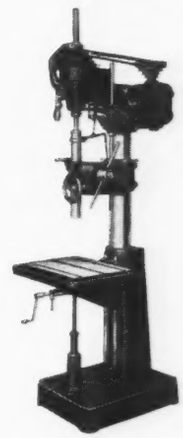
EXTRACTORS, Screw
Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
Union Twist Drill Co.



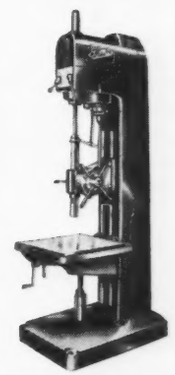
Your Buffalo Drill Team . . .

—READY TO "TEAM UP" WITH YOUR OPERATION AND YOUR BUDGET

Like a precision team, the complete "Buffalo" line of production and tool room drills are smooth co-operators in industry's drive to turn out more and more goods at lower cost.



Any "Buffalo" drill you need—from the speedy, rugged "14" to the powerful, easy-handling "22"—is ready to join your production team and help you score high profits.

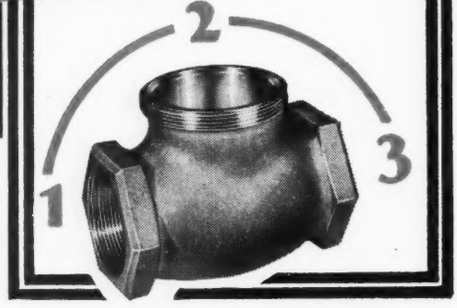


For Full Information Write:

BUFFALO FORGE COMPANY
440 Broadway **Buffalo, New York**
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo" DRILLS

ALL ENDS OF PARTS
Completely Finished
ON THE
"1·2·3"
GOSS and DeLEEUW
Automatic Chucking Machine
in **1 SET-UP**

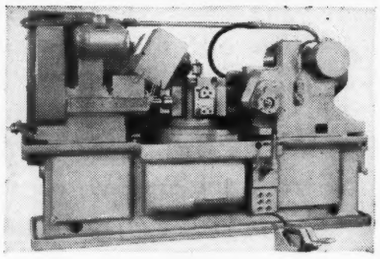


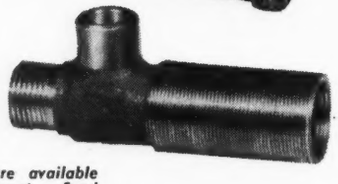
This recent Goss & DeLeeuw development has already received universal acclaim as an outstanding development.

In speed, ease of tooling and precision finishing, the "1-2-3" chucker provides engineering advantages which result in vastly greater production at a fraction of parts' costs by other methods.

Easy, fast change-over from job to job makes this machine ideal for short-run requirements. Sturdy construction, power and speed make its advantages apparent on long runs.

"1-2-3" means ability to handle work requiring machining operations on one, two or three ends simultaneously or in sequence—a method exclusive with Goss & DeLeeuw and offered on this machine.





Illustrated literature available promptly on request. Send samples of your work for time and cost estimates.

GOSS & DeLEEUW
QUALITY PRODUCT-QUANTITY PRODUCTION

GOSS and DeLEEUW
MACHINE COMPANY, *KENSINGTON, CONN., U.S.A.*

FACING MACHINES
Ex-Cell-O Corp.
National Automatic Tool Co.

FANS, Exhaust, Electric Ventilating
Buffalo Forge Co.
General Electric Co.

FEEDS FOR PRESSES, Automatic
U. S. Tool Co., Inc.
V&O Press Co., Div. Rockwell Mfg. Co.

FELT, For All Applications
American Felt Co.
Felters Co.

FILES, Hand
Nicholson File Co.

FILES, Machine
Oliver Instrument Co.

FILES AND BURS, Rotary
Jarvis, Charles L., Co.
Pratt & Whitney

FILING MACHINES, Dies, Etc.
DoAll Co.
Grob Brothers
Jarvis, Charles L., Co.
Oliver Instrument Co.

FINISHES FOR MACHINES AND METAL PARTS
Lowe Brothers Co.

FLEXIBLE COUPLINGS
See Couplings, Flexible.

FLEXIBLE SHAFT EQUIPMENT
Jarvis, Charles L., Co.
Pratt & Whitney
Walker-Turner Div., Kearney & Trecker Corp.

FORGING (Upsetting) MACHINES
Ajax Manufacturing Co.
Baldwin Locomotive Works
Hill Acme Co.
National Machinery Co.

FORGINGS, Drop
Bethlehem Steel Co.
Kropp Forge Co.
Williams, J. H., & Co.

FORGINGS, Hollow Bored
American Hollow Boring Co.
Bethlehem Steel Co.
National Forge & Ordnance Co.

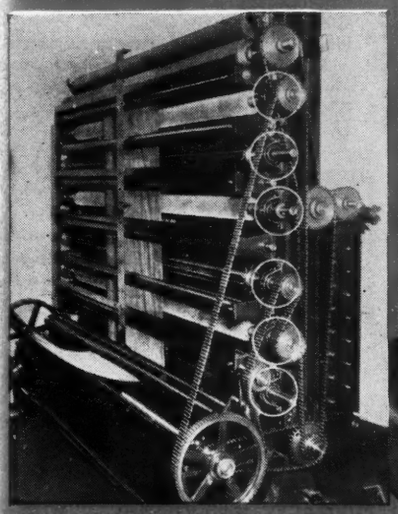
FORGINGS, Iron and Steel
Bethlehem Steel Co.
Jones & Laughlin Steel Corp.
Kropp Forge Co.
Morgan Engineering Co.

FORGINGS, Manganese, Bronze, Etc.
Baldwin Locomotive Works

FORGINGS, Upset
Bethlehem Steel Co.
Kropp Forge Co.
Williams, J. H., & Co.

FORMING AND BENDING MACHINES
Baldwin Locomotive Works
Bethlehem Steel Co.
Chambersburg Engineering Co.
Cincinnati Shaper Co.
Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.
Elmes Engineering Div., American Steel Foundries
Hannifin Corp.
Niagara Machine & Tool Wks.
O'Neil-Irwin Mfg. Co.
Yoder Co.

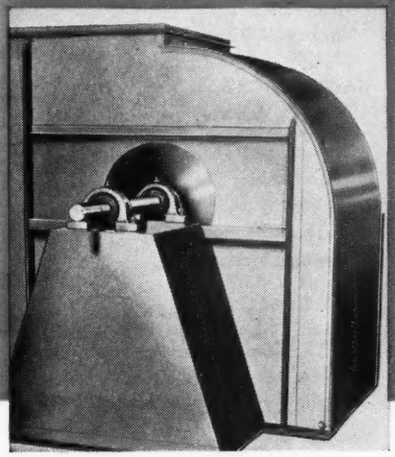
(Continued on page 320)

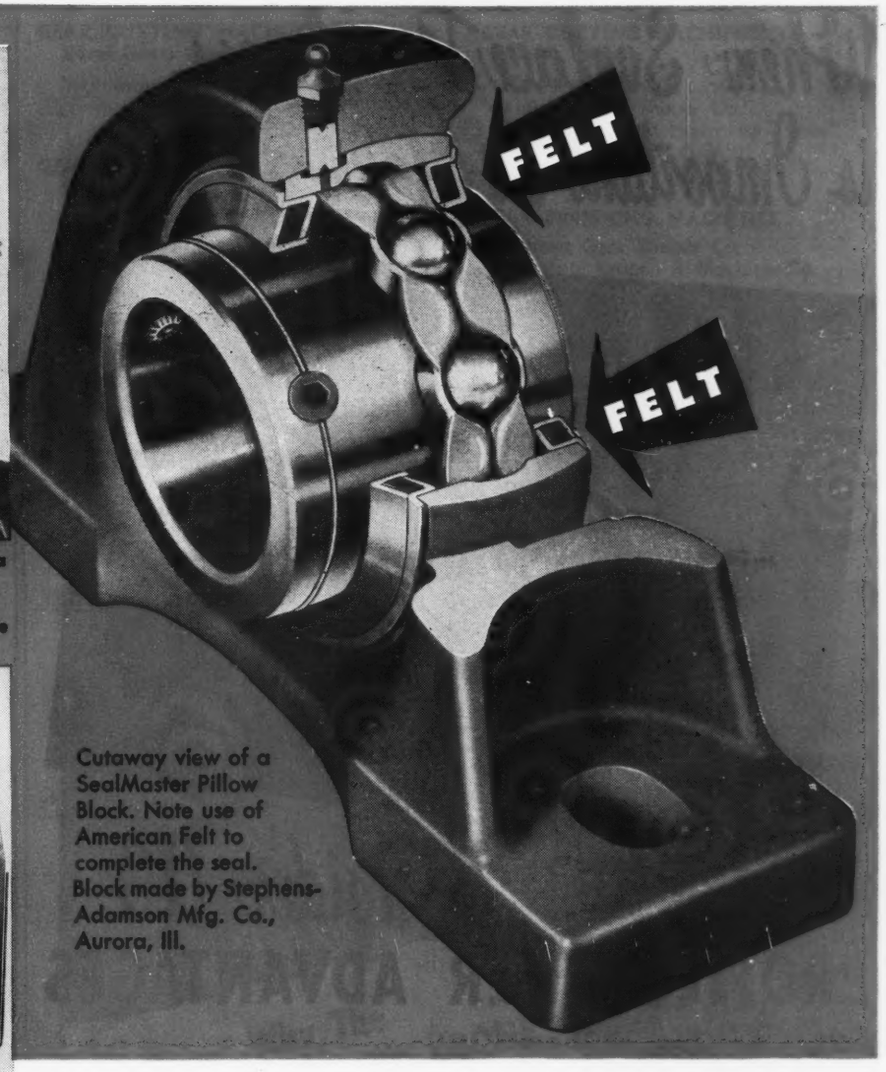


Circles show SealMaster pillow blocks in a textile machine, a worsted despecker.

•

SealMaster pillow blocks on shaft of large fan for air-conditioning systems.





Cutaway view of a SealMaster Pillow Block. Note use of American Felt to complete the seal. Block made by Stephens-Adamson Mfg. Co., Aurora, Ill.

Let's LOOK INTO the Use of FELT by SEALMASTER

• Here is an exceptionally interesting example of the use of American Felt in a bearing seal. Note that the seal consists of an inner labyrinth ring pressed into the outer race of the bearing, an outer flinger ring pressed onto the inner race of the bearing, and a ring of felt in the channel between the two. The felt rotates with the outer ring, and as it is assembled without pressure, there is no danger of glazing or wear.

Now let's see what happens in service. Due to the rotation of the outer steel ring and the felt ring, a centrifugal action is developed. Three effects result from this action in combination with the design of the labyrinth: 1, entry of dirt into the seal is prevented; 2, excess grease that may work its way past the vortex or trap created by the steel seal ring on the outer race passes slowly through the felt; 3, the felt is kept clean and free from glazing. When rotation stops there are still the same barriers, except the centrifugal. No wonder these pillow blocks run for years with such protection!

• American provides various types of felt, plain or laminated with impervious materials, to meet the need for reliable seals. Write for authoritative Data Sheet No. 11, "Felt Seals, Their Design and Application", complete with illustrative samples.

American Felt Company

TRADE MARK

GENERAL OFFICES: 20 GLENVILLE ROAD, GLENVILLE, CONN.
ENGINEERING AND RESEARCH LABORATORIES: GLENVILLE, CONN.
—PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I.—SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, Montreal.

For more information on products advertised, use Inquiry Card, Page 225

When Surface Roughness is Important in Your Shop

Consider All PROFILOMETER ADVANTAGES

Here Are Two of Them:

1. By no other measuring method can you secure roughness ratings on as wide a variety of surfaces. In the standard Profilometer line is equipment for measuring most "hard-to-reach" surfaces, for securing readings on a cylindrical path, or even for checking the finish of ball bearings. The Profilometer, too, measures over any desired *length* of trace—from ⅛" up to several feet.

If you want versatility in a surface roughness measuring instrument, you'll want the Profilometer.

2. By no other measuring method can you get roughness ratings *as fast* and *as accurately* as with the Profilometer. Its normal tracing speed is much faster than that of any other instrument of its type. Throughout the tracing operations, direct dial readings provide precise measurements in microinch units (millionths of an inch).

If you want speed and dependable accuracy in rating surface roughness, you'll want the Profilometer.

GET THE WHOLE STORY of the Profilometer and its many applications. Write for bulletins L-6 and L-11 today.

Profilometer is a registered trade name.

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Instrument Manufacturers
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FORMING AND STAMPING MACHINES
Chambersburg Engineering Co.
Cincinnati Shaper Co.
Henry & Wright Div. of Hartford-Empire Co.
Hydropress, Inc.
Niagara Machine & Tool Wks.
U. S. Tool Co., Inc.

FORMING TOOLS or Tool Blanks
Brown & Sharpe Mfg. Co.
Kennametal, Inc.
National Broach & Mch. Co.
Pratt & Whitney

FRICTION MATERIAL (Brake Lining and Clutch Facing)
Raybestos-Manhattan, Inc., Manhattan Rubber Div.

FURNACES, Hardness
Leeds & Northrup Co.

FURNACES, Heat-Treating
General Electric Co.
Leeds & Northrup Co.
Westinghouse Electric Corp.

FURNITURE, Shop
Standard Pressed Steel Co.

GAGE BLOCKS
Pratt & Whitney
Scherr, George, Co., Inc.
Taft-Peirce Manufacturing Co.
Van Keuren Co.

GAGES, Air
Federal Products Co.
Pratt & Whitney
Sheffield Corp.

GAGES, Comparator
Ames, B. C., Co.
Federal Products Corp.
Jones & Lamson Machine Co.
Pratt & Whitney
Scherr, George, Co., Inc.
Sheffield Corp.
Standard Gage Co., Inc.
Taft-Peirce Manufacturing Co.

GAGES, Depth
Ames, B. C., Co. (Dial)
Brown & Sharpe Mfg. Co.
Federal Products Corp.
Scherr, George, Co., Inc.
Standard Gage Co., Inc.
Starrett, The L. S., Co.

GAGES, Dial
Ames, B. C., Co.
Bristol Co.
Brown & Sharpe Mfg. Co.
Federal Products Corp.
Scherr, George, Co., Inc.
Sheffield Corp.
Standard Gage Co., Inc.
Starrett, The L. S., Co.

GAGES, Electric
Federal Products Co.
Pratt & Whitney
Sheffield Corp.

GAGES, Height
Ames, B. C., Co.
Brown & Sharpe Mfg. Co.
Pratt & Whitney
Scherr, George, Co., Inc.
Starrett, The L. S., Co.

For more information on products advertised, use Inquiry Card, Page 225

GAGES, Plug, Ring and Snap
Axelson Mfg. Co.
Brown & Sharpe Mfg. Co.
Carboloy Co., Inc.
Ex-Cell-O Corp.
Federal Products Corp.
Greenfield Tap & Die Corp.
Kennametal, Inc.
Metal Carbides Corp.
Morse Twist Drill & Machine Co.
Pratt & Whitney
Scherr, George, Co., Inc.
Sheffield Corp.
Standard Gage Co., Inc.
Starrett, The L. S., Co.
Van Keuren Co.

GAGES, Surface
Ames, B. C., Co.
Brown & Sharpe Mfg. Co.
Columbus Die, Tool & Mch. Co.
Starrett, The L. S., Co.

GAGES, Taper
Brown & Sharpe Mfg. Co.
Engis Equipment Co.
Pratt & Whitney
Sheffield Corp.
Starrett, The L. S., Co.

GAGES, Thread
Axelson Mfg. Co.
Bath, John, Co., Inc.
Federal Products Corp.
Hanson-Whitney Co.
Greenfield Tap & Die Corp.
Pratt & Whitney
Sheffield Corp.
Taft-Peirce Manufacturing Co

GASKETS
Garlock Packing Co.
Raybestos-Manhattan, Inc., Manhattan Rubber Div.

GEAR BLANKS, Non-Metallic
Braun Gear Co.
Ganschow Gear Co.
General Electric Co.
Westinghouse Electric Corp.

GEAR BURNISHING MACHINES
Fellows Gear Shaper Co.
Sheffield Corp.

GEAR CHAMFERING, ROUNDING AND BURRING MACHINES
Bilgram Gear & Machine Works
Consolidated Mch. Tool Corp.
Cross Co.
Sheffield Corp.

GEAR CHECKING INSTRUMENTS AND EQUIPMENT
Brown & Sharpe Mfg. Co.
Eastman Kodak Co.
Fellows Gear Shaper Co.
Gleason Works
National Broach & Mch. Co.
Scherr, George, Co., Inc.
Starrett, The L. S., Co.

GEAR CUTTING MACHINES, Bevel Gears (Generator)
Bilgram Gear & Machine Works
Gleason Works

GEAR CUTTING MACHINES, Bevel Gears, Spiral
Gleason Works

GEAR CUTTING MACHINES, Spur and Bevel Gears (Rotary Cutter)
Waltham Machine Works

GEAR CUTTING MACHINES, Spur and Helical Gears (Hobbing)
Barber-Colman Co.
New Jersey Gear & Mfg. Co.

GEAR CUTTING MACHINES, Spur and Helical Gears (Shaper or Planer Type)
Farrel-Birmingham Co., Inc.
Fellows Gear Shaper Co.
National Tool Co.

GEAR CUTTING MACHINES, Worm and Worm Wheels
Barber-Colman Co.
Fellows Gear Shaper Co. (Straight and Hourglass Types)
New Jersey Gear & Mfg. Co.

GEAR FINISHING MACHINES
Fellows Gear Shaper Co.
National Broach & Machine Co.

GEAR GRINDING MACHINES
Gleason Works
National Broach & Machine Co.
National Tool Co.
Pratt & Whitney

Why The
GEAR WITH A BACKBONE
Fits Into Machine Design
Here are two reasons why the Farrel-Sykes continuous-tooth, herringbone gear—the famous *Gear with a Backbone*—is ideal for machine-tool applications.
1. PRECISION GENERATION — The Farrel-Sykes method of generation assures extreme accuracy of tooth spacing, contour and helix angle. This tooth-to-tooth accuracy pays off in smooth, uniform power flow. Backlash is reduced to a minimum and the load is distributed evenly across the entire face width.
2. BACKBONE — The *backbone*, formed where the two helices meet without a center groove, puts the entire face width to work and provides extra strength and higher load-carrying capacity in less space — a definite advantage in many applications.
The precision generated Gear with a Backbone is available in any size up to 20 feet in diameter, for practically any application. Information and engineering assistance available, without obligation.
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FB-589

GEAR HARDENING MACHINES
Gleason Works

GEAR LAPPING MACHINES
Fellows Gear Shaper Co.
Gleason Works
National Broach & Machine Co.

GEAR MOTORS
See Speed Reducers.

GEAR SHAVING MACHINES
Fellows Gear Shaper Co.
National Broach & Machine Co.

GEAR TESTING MACHINERY
Baldwin Locomotive Works
Brown & Sharpe Mfg. Co.
Farrel-Birmingham Co., Inc.
Fellows Gear Shaper Co.
Gleason Works
National Broach & Machine Co.
National Tool Co.
Scherr, George, Co., Inc.

GEARS, Cut
Atlantic Gear Works, Inc.
Bilgram Gear & Machine Works
Boston Gear Works, Inc.
Braun Gear Co.
Cincinnati Gear Co.
Cleveland Worm & Gear Co.
Cone Drive Gears Div., Michigan Tool Co.
Diefendorf Gear Corp.
Earle Gear & Machine Co.
Fairfield Mfg. Co.
Farrel-Birmingham Co., Inc.
Ganschow Gear Co.
Gear Specialties, Inc.
Gleason Works
Greaves Machine Tool Co.
Hartford Special Mchry. Co.
Massachusetts Gear & Tool Co.
Meisel Press Mfg. Co.
National-Erie Corp.
New Jersey Gear & Mfg. Co.
Ohio Gear Co.
Perkins Mch. & Gear Co.
Philadelphia Gear Works
Stahl Gear & Machine Co.
Westinghouse Electric Corp.

GEARS, Molded
National-Erie Corp.
Westinghouse Electric Corp.

GEARS, Rawhide and Non-Metallic
Atlantic Gear Works, Inc.
Boston Gear Works, Inc.
Braun Gear Co.
Cincinnati Gear Co.
Diefendorf Gear Corp.
Earle Gear & Machine Co.
Ganschow Gear Co.
Gear Specialties, Inc.
Hartford Special Mchry. Co.
Massachusetts Gear & Tool Co.
Meisel Press Mfg. Co.
Ohio Gear Co.
Philadelphia Gear Works
Stahl Gear & Machine Co.
Westinghouse Electric Corp.

GENERATORS, Electric
General Electric Co.
Reliance Elec. & Engrg. Co.
Westinghouse Electric Corp.

GOGGLES
American Optical Co.

GRADUATING MACHINES
Abrasive Machine Tool Co.
Gorton, George, Machine Co.
Greaves Machine Tool Co.

GREASES
Cities Service Oil Co.
Gulf Oil Corp.
Lubriplate Div., Fiske Bros. Refining Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
Sun Oil Co.
Texas Co.
Tide Water Associated Oil Co.

GRINDERS, Carbide Tool
Oliver Instrument Co.

GRINDERS, Die and Mold
Consolidated Mch. Tool Corp.
Pratt & Whitney

GRINDERS, Oilstone, for Woodworking Tools
Mummert-Dixon Co.

GRINDERS, Pneumatic
Chicago Pneumatic Tool Co.
Madison-Kipp Corp.

GRINDERS, Portable Electric and Toolpost
Chicago Pneumatic Tool Co.
Jarvis, Charles L., Co.
Van Dorn Electric Tool Co.

NEW tapping head SLASHES COSTS on large hole tap jobs!

★ **Production increased as much as 100%**

★ **Drastic reduction in spoilage**

★ **Greatly increased tap life**

This completely new Procunier "TAP KING" high speed tap head is revolutionizing methods . . . drastically **cutting production costs** on difficult large hole tapping jobs. Spectacular daily **production gains** with this new unit have **run as high as 50-100%!** In addition, users reported amazing savings in parts spoilage and consistent, accurate maintenance of uniform tap depth . . . even on large **blind hole** tapping jobs!

Construction features include: capacity ⅜" to 1" in steel and 1⅛" in softer materials; powerful friction clutch, exclusive spline drive to tap holder spindle; ball and needle bearings; rigid, lightweight "TRU-GRIP" tap holder; helical back gear reversing mechanism; lightweight aluminum housing and many other unusual advantages.

Here is the **answer to your toughest large hole tap problems** . . . write for full details today!

Procunier High Speed Tapping Heads are available in 4 sizes with capacities from No. 0 to 1⅛"

NEW! LARGER! Procunier "TRU-GRIP" Tap Saver

Small size makes tapping easier close to walls or shoulders, eliminates "chewed" tap shanks. Lighter, smaller in diameter, it drives the tap by the square, holds it true by the round.

Procunier Safety Chuck Co. Dept. 8
16 S. Clinton St., Chicago 6, Ill.

Gentlemen: Please send me full details on the new Procunier "TAP KING."

Name.....

Address.....

City.....Zone.....State.....

Procunier
Safety Chuck Company
16 S. Clinton St. Chicago 6, Ill.

For more information on products advertised, use Inquiry Card, Page 225

GRINDING FIXTURES, Die Chaser
Geometric Tool Co.

GRINDING MACHINES, Abrasive Belt
DoAll Co.
Hill Acme Co.
Mattison Mch. Wks.
Walker-Turner Div., Kearney & Trecker Corp.
Walls Sales Corp.

GRINDING MACHINES, Bench
Gorton, George, Machine Co.
Hardinge Brothers, Inc.
Ryerson, Joseph T., & Son, Inc.
Van Dorn Electric Tool Co.
Walker-Turner Div., Kearney & Trecker Corp.

GRINDING MACHINES, Broach
Ex-Cell-O Corp.
Lapointe Mch. Tool Co.

GRINDING MACHINES, Camshaft
Landis Tool Co.
Norton Co.

GRINDING MACHINES, Carbide Tool
Arter Grinding Machine Co.
Carboloy Co., Inc.
Ex-Cell-O Corp.
Oliver Instrument Co.

GRINDING MACHINES, Centerless
Cincinnati Grinders Inc.
Heald Machine Co.
Landis Tool Co.

GRINDING MACHINES, Chucking
Bryant Chucking Grinder Co.
Landis Tool Co.

GRINDING MACHINES, Crankshaft
Landis Tool Co.
Norton Co.

GRINDING MACHINES, Cylindrical
Arter Grinding Machine Co.
Brown & Sharpe Mfg. Co.
Cincinnati Grinders Inc.
Landis Tool Co.
Norton Co.

GRINDING MACHINES, Die Chaser
Eastern Mch. Screw Corp.
Landis Machine Co.

GRINDING MACHINES, Disc
Besly, Chas. H., & Co.
Gardner Machine Co.
Mattison Machine Works

GRINDING MACHINES, Drill
Blake, Edward, Co.
Gallmeyer & Livingston Co.
Oliver Instrument Co.
Union Twist Drill Co.

GRINDING MACHINES, Face
Abrasive Machine Tool Co.
Mattison Machine Works
Oliver Instrument Co.

GRINDING MACHINES, Flexible Shaft
See Flexible Shaft Equipment.

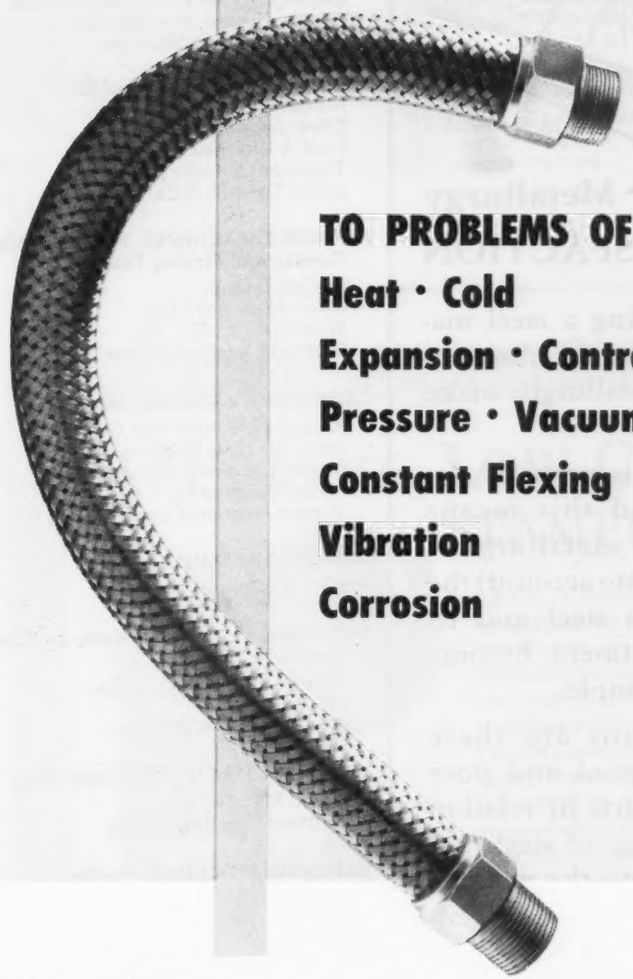
GRINDING MACHINES, Gap
Cincinnati Grinders Inc.
Landis Tool Co.

GRINDING MACHINES, Gear Tooth
See Gear Grinding Machines.

GRINDING MACHINES, For Sharpening Cutters, Reamers, Hobs, Etc.
Barber-Colman Co.

(Continued on page 324)

Economical Answer



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Heat · Cold
Expansion · Contraction
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Constant Flexing
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Titeflex All-Metal Flexible Tubing

If you use tubing to convey gases, liquids or semi-solids, chances are Titeflex can help you do it better, at less cost. There's a type of Titeflex for almost every need—and all Titeflex is *all-metal*, to last longer in any kind of service. Get the facts. Write for complete catalog.

★ Five metals—brass, bronze, stainless, monel, inconel
★ Types and sizes to withstand temperatures to 1525° F.
★ Types and sizes to withstand pressures to 6800 lbs. p.s.i.
★ Supplied with any style of fittings
★ Stays flexible and stays tight under severe conditions

Titeflex, Inc.

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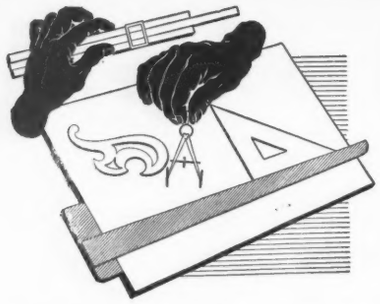
TITEFLEX STAYS TIGHT WHEN THE GOING IS TOUGH



Design + Metallurgy = SATISFACTION

For specifying a steel machinery part, the designer and the metallurgist make a fine team.

If the part is properly designed (and this means taking the metallurgical treatment into account) the choice of a steel and its proper treatment become relatively simple.

So important are these aspects of good and poor design of parts in relation to the choice of steel and its treatment—the work of the designer and the metallurgist—that we have compiled a 70-page book on this subject, giving many sketches as examples. "THREE KEYS TO SATISFACTION" is interesting and helpful to designers and metallurgists; it is free on request.

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Position.....
Company.....
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MOLY

M8 F-19

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DoAll Co.
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Gallmeyer & Livingston Co.
Giddings & Lewis Machine Tool Co.
Gorton, George, Machine Co.
Ingersoll Milling Mch. Co.
Landis Tool Co.
LeBlond, R. K., Mch. Tool Co.
Norton Co.
Oliver Instrument Co.
Pratt & Whitney
Thompson Grinder Co.
Union Twist Drill Co.

GRINDING MACHINES, For Sharpening Turning and Planing Tools
Ex-Cell-O Corp.
Oliver Instrument Co.
Walker, O. S., Co., Inc.
Waltham Machine Works

GRINDING MACHINES, Internal
Abrasive Machine Tool Co.
Arter Grinding Machine Co.
Bryant Chucking Grinder Co.
Heald Machine Co.
Wicaco Machine Corp.

GRINDING MACHINES, Jig
Pratt & Whitney

GRINDING MACHINES, Knife and Shear Blade
Abrasive Machine Tool Co.
Hill Acme Co.
Mattison Machine Works

GRINDING MACHINES, Piston Ring
Heald Machine Co.
Mattison Machine Works

GRINDING MACHINES, Profile
Sheffield Corp.

GRINDING MACHINES, Radial, Ball Race, Etc.
Landis Tool Co.

GRINDING MACHINES, Radius, Link
Consolidated Mch. Tool Corp.
Sundstrand Mch. Tool Corp.

GRINDING MACHINES, Ring Wheel
Besly, Chas. H., & Co.
Gardner Machine Co.
Mattison Machine Works

GRINDING MACHINES, Roll
Farrel-Birmingham Co., Inc.
Landis Tool Co.
Norton Co.

GRINDING MACHINES, Surface
Abrasive Mch. Tool Co.
Arter Grinding Machine Co.
Blanchard Mch. Co.
Brown & Sharpe Mfg. Co.
DoAll Co.
Gallmeyer & Livingston Co.
Gardner Machine Co.
Heald Machine Co.
Hill Acme Co.
Mattison Machine Works
Norton Co.
Pratt & Whitney
Taft-Peirce Manufacturing Co.
Thompson Grinder Co.
Walker, O. S., Co., Inc.

GRINDING MACHINES, Tap
Blake, Edward, Co.
Ex-Cell-O Corp.
Jones & Lamson Mch. Co.

GRINDING MACHINES, Thread
Ex-Cell-O Corp.
Hanson-Whitney Co.
Jones & Lamson Mch. Co.
Landis Machine Co. (Centerless)
Landis Tool Co. (Centerless)

GRINDING MACHINES, Universal
Brown & Sharpe Mfg. Co.
Cincinnati Grinders Inc.
Landis Tool Co.
Norton Co.

GRINDING MACHINES, Worm
Jones & Lamson Mch. Co.
Pratt & Whitney

GRINDING WHEELS
Bakelite Div., Union Carbide & Carbon Corp.
Besly, Chas. H., & Co.
Blanchard Mch. Co.
Carborundum Co.
Norton Co.
Raybestos-Manhattan, Inc., Manhattan Rubber Div.
Simonds Abrasive Co.

GROOVING TOOLS, Internal
Waldes Kohinoor, Inc.

HAMMERS, Drop
Bliss, E. W., Co.
Chambersburg Engineering Co.
Morgan Engineering Co.

HAMMERS, Forging Air
Lobdell United Co.

HAMMERS, Pneumatic
Chambersburg Engineering Co.
Chicago Pneumatic Tool Co.

HAMMERS, Portable Electric
Van Dorn Electric Tool Co.

HAMMERS, Power
Lobdell United Co.

HAMMERS, Shaft
S K F Industries, Inc.
Standard Pressed Steel Co.

HAMMERS, Soft
Chambersburg Engineering Co.
S. & H. Soft Hammer Products Co.
Williams, J. H., & Co.

HAMMERS, Steam
Chambersburg Engineering Co.

HARDENING EQUIPMENT
Ohio Crankshaft Co.

HARDENING MACHINES, Flame
Cincinnati Milling Machine Co.

HARDNESS TESTING INSTRUMENTS
Shore Instrument & Mfg. Co.
Wilson Mechanical Instrument Co., Inc.

HEADING MACHINES
National Machinery Co.

HEAT TREATMENT OF METALS
Bennett Metal Treating Co.
National-Erie Corp.

For more information on products advertised, use Inquiry Card, Page 225

HOBBING MACHINES
See Gear Cutting Machines, Helical and Spur (Hob), and Gear Cutting Machines, Worm and Worm Wheels

HOBS
Barber-Colman Co.
Brown & Sharpe Mfg. Co.
Hanson-Whitney Co.
National Twist Drill & Tool Co.
New Jersey Gear & Mfg. Co.
Union Twist Drill Co.

HOIST HOOKS
Bethlehem Steel Co.
Williams, J. H., & Co.

HOISTING AND CONVEYING EQUIPMENT
Cleveland Crane & Engrg. Co.
Shepard Niles Crane & Hoist Corp.

HOISTS, Air
Chicago Pneumatic Tool Co.

HOISTS, Chain, Etc.
Ryerson, Joseph T., & Son, Inc.

HOISTS, Electric
Philadelphia Gear Works
Shepard Niles Crane & Hoist Corp.

HONES
Carborundum Co.
Moline Tool Co.
Norton Co.
Sunnen Products Co.

HONING MACHINES, Internal (Cylinder)
Barnes Drill Co.
Barnes, W. F. & John, Co.
Micromatic Hone Corp.
Moline Tool Co.
Sunnen Products Co.

HONING MACHINES, External
Barnes Drill Co.
Micromatic Hone Corp.

HONING MACHINES, Hose, Leather, Rubber, Metallic, Etc.
American Metal Hose Branch, American Brass Co.
Raybestos-Manhattan, Inc., Manhattan Rubber Div.
Titeflex, Inc.

HONING TOOLS AND FIXTURES
Micromatic Hone Corp.

HOSE
American Metal Hose Branch, American Brass Co.

HYDRAULIC MACHINERY, Tools and Equipment
Baldwin Locomotive Works
Barnes, John S., Corp.
Bethlehem Steel Corp.
Birdsboro Steel Fdry. & Mch. Co.
Bliss, E. W., Co.
Chambersburg Engineering Co.
Cross Co.
Denison Engineering Co.
Elmes Engineering Div., American Steel Foundries
Farquhar, A. B., Co.
Hannifin Corp.
Hydropress, Inc.
Lake Erie Engineering Corp.
Lima-Hamilton Corp.
National-Erie Corp.
Oilgear Co.
Rockford Machine Tool Co.
Sundstrand Mch. Tool Co.
Vickers, Inc.

HYDRAULIC POWER UNITS OR TOOL HEADS
Barnes Drill Co.
Barnes, John S., Corp.
Barnes, W. F. and John, Co.
Ex-Cell-O Corp.
Hannifin Corp.
Vickers, Inc.

INDEX CENTERS
Abrasive Mch. Tool Co.
Brown & Sharpe Mfg. Co.
Engis Equipment Co.
Rockford Machine Tool Co.

INDEXING AND SPACING EQUIPMENT
Hartford Special Mchry. Co.
Sundstrand Machine Tool Co.

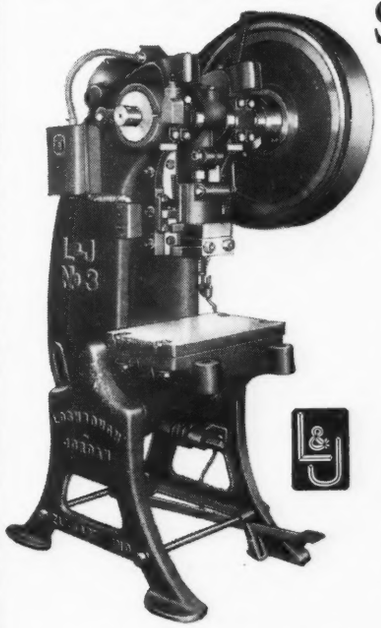
INDICATORS, Dial
Ames, B. C., Co.
Brown & Sharpe Mfg. Co.
Federal Products Corp.
Standard Gage Co., Inc.
Starrett, The L. S., Co.

INDICATORS, Speed
Bristol Co.
Brown & Sharpe Mfg. Co.
Starrett, The L. S., Co
Veeder-Root Inc.

INDICATORS, Test
Ames, B. C., Co.

(Continued on page 326)

ACCURATE, LOW-COST STAMPINGS



L & J No. 3 Presses have made a reputation for themselves in cost-conscious press shops. For nearly 40 years they have been stamping and drawing a limitless variety of parts accurately and quickly. Constantly improved to maintain this record in spite of growing production demands, they offer numerous advantages.

These rugged presses have heavy, deflection-resistant frames and precision slides with extra long gibs to insure maximum accuracy and long die life. They are easy to adjust and easy to operate. Maintenance is minimized by proper design and highest quality. And L & J's new friction clutch can be had as optional equipment for even faster production.

L & J No. 3 O.B.I. PRESS

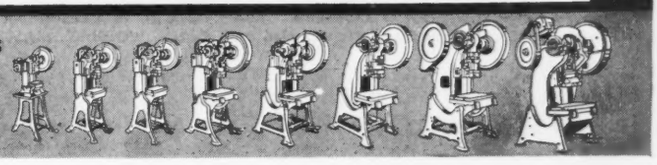
CAPACITY.....22 tons
STROKE.....2½" standard—others optional
STROKES PER MINUTE.....127 standard
DIE SPACE.....8¼" (standard) or 10¼"
(bed to slide, stroke down, adjustment up)
BOLSTER AREA.....21½" x 12½"
(right to left x front to back)

Also, 11 other models, 6 to 80 ton capacities.

Write for literature

L&J PRESS
C O R P O R A T I O N
SUCCESSORS TO LOSHBOUGH-JORDAN TOOL & MACHINE CO. ESTABLISHED 1910
1631 STERLING AVENUE, ELKHART, INDIANA

O.B.I. PRESSES
12 Models
6 to 80 Ton
Capacities



Brown & Sharpe Mfg. Co.
Federal Products Corp.
Standard Gage Co., Inc.
Starrett, The L. S., Co

INDUCTION HEATING EQUIPMENT
Ohio Crankshaft Co.

INTENSIFIERS, Hydraulic
Baldwin Locomotive Works
Farquhar, A. B., Co.
Hydropress, Inc.
Morgan Engineering Co.

JACKS, Planer
Armstrong Bros. Tool Co.

JIG BORER
See Boring Machines, Jig.

JIGS AND FIXTURES
Allied Products Corp.
Columbus Die, Tool & Mch. Co.
Ex-Cell-O Corp.
Hartford Special Mchry. Co.
Ingersoll Milling Mch. Co.
Logansport Machine Co., Inc.
Sheffield Corp.
Snow Mfg. Co.
Sundstrand Mch. Tool Co.

JOINTS, See Fittings, Hydraulic, Pneumatic, Etc.

KEYSEATERS
Baker Bros., Inc.
Consolidated Mch. Tool Corp.
Davis Keyseater Co.
Lapointe Machine Tool Co.
Mitts & Merrill

KNURL HOLDERS
Brown & Sharpe Mfg. Co.
Pratt & Whitney

KNURLING TOOLS
Armstrong Bros. Tool Co.
Pratt & Whitney
Williams, J. H., & Co.

LAPPING MACHINES
Cincinnati Grinders Inc. (Centerless)
Crane Packing Co. (Lapmaster Div.)
Ex-Cell-O Corp.
Fellows Gear Shaper Co.
Micromatic Hone Corp.
Norton Co.

LATHE AND GRINDING DOGS
Armstrong Bros. Tool Co.
Williams, J. H., & Co.

LATHE ATTACHMENTS
American Tool Wks. Co.
Cincinnati Lathe & Tool Co.
Gisholt Mch. Co.
Hendey Machine Co.
Jones & Lamson Mch. Co.
King Machine Tool Div., American Steel Foundries (Sebastian)
LeBlond, R. K., Mch. Tool Co.
Lodge & Shipley Co.
Monarch Mch. Tool Co.
Pratt & Whitney
Rockford Machine Tool Co.
Seneca Falls Mch. Co.
Springfield Mch. Tool Co.
Sundstrand Mch. Tool Co.
Warner & Swasey Co.

LATHES, Automatic
Baird Machine Co.
Bullard Co.
Cone Automatic Machine Co., Inc.
Cross Co.
Gisholt Mch. Co.
Goss & DeLeeuw Mch. Co.
Jones & Lamson Mch. Co.
LeBlond, R. K., Mch. Tool Co.
Monarch Mch. Tool Co.
National Acme Co.
New Britain Machine Co., New Britain-Gridley Mch. Div.
Potter & Johnston Co.
Pratt & Whitney
Seneca Falls Mch. Co.
Sundstrand Mch. Tool Co.

LATHES, Axle
Consolidated Mch. Tool Corp.
LeBlond, R. K., Mch. Tool Co.
Seneca Falls Mch. Co.
Sundstrand Mch. Tool Co.

LATHES, Bench
Hardinge Brothers, Inc.
LeBlond, R. K., Mch. Tool Co.
Pratt & Whitney
Seneca Falls Mch. Co.
Sheldon, Mch. Co., Inc.

LATHES, Boring
Gisholt Mch. Co.
LeBlond, R. K., Mch. Tool Co.
Lodge & Shipley Co.

LATHES, Crankshaft
Consolidated Mch. Tool Corp.
LeBlond, R. K., Mch. Tool Co.
Sundstrand Mch. Tool Co.

LATHES, Double-End
Consolidated Mch. Tool Corp.
LeBlond, R. K., Mch. Tool Co.
Sundstrand Mch. Tool Co.

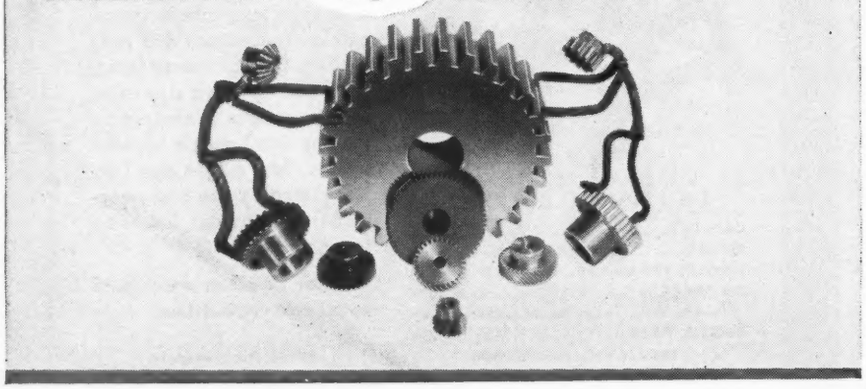
LATHES, Engine and Toolroom
American Tool Wks. Co.
Axelson Manufacturing Co.
Cincinnati Lathe & Tool Co.
Consolidated Mch. Tool Corp.
DoAll Co.
Greaves Machine Tool Co.
Hendey Machine Co.
King Machine Tool Div., American Steel Foundries (Sebastian)
LeBlond, R. K., Mch. Tool Co.
Lehman Machine Co.
Lodge & Shipley Co.
Monarch Mch. Tool Co.
Morey Mchry. Co., Inc.
Pratt & Whitney
Rockford Machine Tool Co.
Seneca Falls Mch. Co.
Sheldon Mch. Co., Inc.
Sidney Machine Tool Co.
Simmons Machine Tool Corp.
Springfield Mch. Tool Co.

LATHES, Form Turning
Monarch Mch. Tool Co.

LATHES, Gap
Cincinnati Lathe & Tool Co.
Gisholt Mch. Co.
King Machine Tool Div., American Steel Foundries (Sebastian)
LeBlond, R. K., Mch. Tool Co.
Lodge & Shipley Co.
Seneca Falls Mch. Co.
Warner & Swasey Co.

LATHES, Gun
Consolidated Mch. Tool Corp.
LeBlond, R. K., Mch. Tool Co.
Seneca Falls Mch. Co.
Springfield Mch. Tool Co.

Mass. G&T Co. Gear



for FAST SERVICE on all types of MEDIUM AND SMALL SIZE GEARS

Many members of the Mass. Gear organization have been with the company since its founding twenty-eight years ago. They have grown up with "Mass. Gear" . . . in planning, producing, inspecting and shipping.

Their long-experienced "know-how" has been concentrated on the interpretation of customer requirements and in meeting them intelligently and promptly.

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If you have a gear problem, let Mass. Gear help you. Write for a free catalog to MASSACHUSETTS GEAR and TOOL COMPANY, WOBURN, MASS.

Massachusetts Gear & Tool Co.

For more information on products advertised, use Inquiry Card, Page 225

LATHES, Hollow Spindle
LeBlond, R. K., Mch. Tool Co.
Lehman Muchine Co.

LATHES, Manufacturing Type
Lodge & Shipley Co.

LATHES, Spinning
Bliss, E. W., Co.

LATHES, Toolroom
See Lathes, Engine and Toolroom

LATHES, Turret
Bardons & Oliver, Inc.
Brown & Sharpe Mfg. Co.
Bullard Company
Gisholt Mch. Co. (Automatic)
Hardinge Brothers, Inc.
(Bench or Cabinet Mounting)
Jones & Lamson Mch. Co.
King Machine Tool Div., American Steel Foundries (Sebastian)
LeBlond, R. K., Mch. Tool Co.
Lodge & Shipley Co.
Millholland, W. K., Machinery Co.
Morey Mchry. Co., Inc.
Potter & Johnston Co. (Automatic)
Simmons Machine Tool Corp.
Springfield Mch. Tool Co.
Warner & Swasey Co.

LATHES, Vertical Turret
Bullard Company
King Machine Tool Div., American Steel Foundries
Rogers Machine Works, Inc.

LEVELS
Pratt & Whitney
Starrett, The L. S., Co.

LUBRICANTS, Including Extreme Pressure (EP) Machinery Lubricants
Cities Service Oil Co.
Gulf Oil Corp.
Lubriplate Div., Fiske Bros. Refining Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
Stuart, D. A., Oil Co., Ltd.
Sun Oil Co.
Texas Co.
Tide Water Associated Oil Co.

LUBRICATING SYSTEMS
Madison-Kipp Corp.
Manzel, Inc.

MACHINISTS' SMALL TOOLS
See Calipers, Hammers, Wrenches, Drills, Taps, Etc.

MANDRELS
See Arbors and Mandrels.

MARKING MACHINES AND DEVICES
Colonial Broach Co.

MEASURING MACHINES AND INSTRUMENTS, PRECISION
Federal Products Corp.
Norma-Hoffmann Bearings Corp.
Pratt & Whitney
Scherr, George, Co., Inc.
Starrett, The L. S., Co.
Van Keuren Co.

MEASURING WIRES, THREAD, SPLINE AND GEAR
Van Keuren Co.

METAL, Bearings
See Bearings, Bronze, Babbitt, Etc., and Bushings, Brass, Bronze, Etc.

For HEAVY DUTY SERVICE

Drive Shafts of

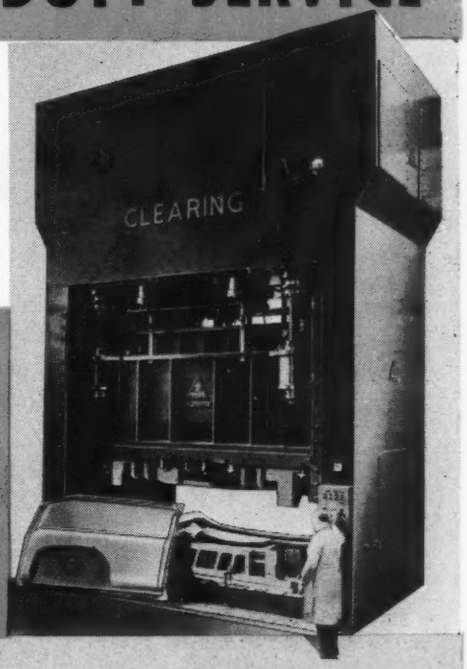
CLEARING PRESSES

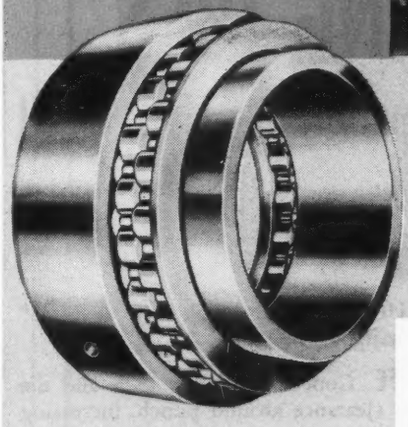
rotate on

ORANGE

"STAGGERED"

ROLLER BEARINGS





Clearing Hydraulic and Mechanical Presses exert accurate pressures up to thousands of tons—turn out huge sections of car bodies in a single stamping. Clearing engineers find Orange Staggered Roller Bearings best suited to withstand the severe service in the drive shafts of Clearing Presses and have been using these bearings with excellent success for 10 years.

How unique staggered and meshed roller design provides greater load carrying capacity

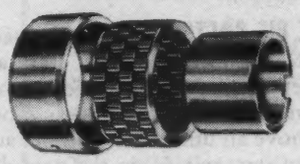


Illustration above shows how load is divided over many short rolls instead of a few full length rolls. At left, end views of Staggered bearing and conventional bearing show how staggered roller design brings a multiplicity of contact points within the loaded zone.

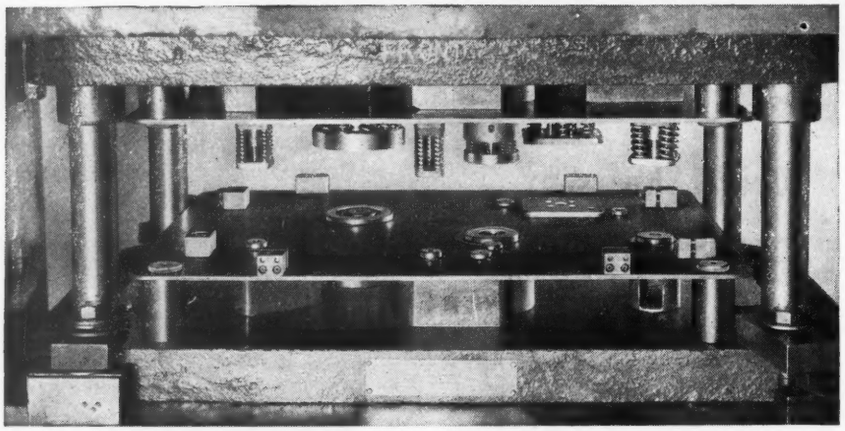
DO THE WORK OF LARGER-SIZE CONVENTIONAL BEARINGS

Wherever designs call for bearings combining extreme ruggedness, high load carrying capacity and precision running—be sure to study the capacities of Orange Staggered Roller Bearings. Size for size, they carry higher loads than conventional roller bearings. Used in new designs, you can carry the required load with smaller size Staggered bearings and save space. Used as changeovers in present equipment, you gain extra load capacity and longer service life.

Orange Staggered Roller Bearings are available in a full range of interchangeable sizes—in the 200 and 300 series, from 305 to SW-244, and in the 5200 and 5300 series, from 5306 to 5334. Also with notched-type inner race, supplied with separable outer and inner races, as required. Special sizes to order.

WRITE FOR ENGINEERING DATA FOLDER
showing construction, types, sizes, capacities, installation data, etc.

ORANGE ROLLER BEARING CO., INC.
552 Main Street, Orange, N. J.



● Magnetic Perforating Die set-up in small inclinable punch press.

Magnetic PERFORATING DIES

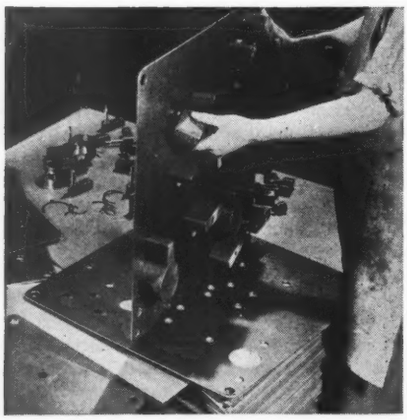
NEW and FAST Method for perforating Sheet Metal

SAVE PRESS DOWN TIME. Approximately 15 minutes required to change from punching one subject of say 20 holes to a different 20 hole arrangement. Whistler Magnetic Perforating Dies *increase* press production.

HOLD CLOSE TOLERANCES. Hole centers may be held to .0005" accuracy or as close as can be jig bored.

GREATER PUNCH AND DIE LIFE. Concentricity of punch and die assured thus giving uniform clearance around punch, increasing punch and die life.

SAVE FLOOR SPACE. Die storage cut to a minimum because only the 2 locating templets are stored...all that is required to duplicate the set-up.



● Die retainers complete with bushings being inserted in die templet.

REDUCE DIE COSTS. Whistler Magnetic Perforating Punch and Die units are used repeatedly for different hole arrangements. When completing one job, remove all units from templet and put them into service on the next different set-up. Combine any number of hole sizes and shapes. Punch and die costs are amortized over continued reuse in many jobs.

Write for Catalog...

Whistler Magnetic Perforating Punches and Dies have *proven* their cost-cutting advantages in many prominent plants. The catalog shows how. Send for it today.

S. B. WHISTLER & SONS, Inc.

736 MILITARY ROAD, BUFFALO 17, NEW YORK

Also manufacturers of a complete line of drawing, forming, blanking and progressive dies to special requirements.

METALS, Perforated
Chicago Perforating Co.

METERS
See Recording Instruments.

MICROMETERS
Ames, B. C., Co. (Dial)
Bath, John, Co., Inc.
Brown & Sharpe Mfg. Co.
Pratt & Whitney
Scherr, George, Co., Inc.
Starrett, The L. S., Co.
Van Keuren Co.

MICROSCOPES, Toolmakers
Engis Equipment Co.
Scherr, George, Co., Inc.

MILLING ATTACHMENTS
Brown & Sharpe Mfg. Co.
Cincinnati Milling Machine Co.
Consolidated Mch. Tool Corp.
Gorton, George, Machine Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Pratt & Whitney
Sundstrand Mch. Tool Co.
Van Norman Co.

MILLING AND CENTERING MACHINES
Davis & Thompson Co.
Jones & Lamson Mch. Co. (Automatic)
Sundstrand Mch. Tool Co.

MILLING MACHINES, Automatic
Cincinnati Milling Machine Co.
Consolidated Mch. Tool Corp.
Cross Co.
Ingersoll Milling Mch. Co.
Jones & Lamson Mch. Co.
Kearney & Trecker Corp.
Pratt & Whitney
Sundstrand Mch. Tool Co.
U. S. Tool Company, Inc.

MILLING MACHINES, Bench
Hardinge Brothers, Inc.
(Bench or Pedestal Type)
Pratt & Whitney

MILLING MACHINES, Circular Continuous
Consolidated Mch. Tool Corp.
Davis & Thompson Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Sundstrand Machine Tool Co.

MILLING MACHINES, Die Sinking
See Die Sinking Machines.

MILLING MACHINES, Duplex
Cincinnati Milling Machine Co.
Consolidated Mch. Tool Corp.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Sundstrand Machine Tool Co.
Taylor & Fenn Co.
U. S. Tool Co., Inc.

MILLING MACHINES, Hand
Nichols, W. H., Co.
U. S. Tool Co., Inc.
Van Norman Co.

MILLING MACHINES, Horizontal, Plain and Universal
Brown & Sharpe Mfg. Co.
Cincinnati Milling Machine Co.
Consolidated Mch. Tool Corp.

For more information on products advertised, use Inquiry Card, Page 225

DeVlieg Machine Co.
DoAll Co.
Gorton, George, Machine Co.
Greaves Machine Tool Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Pratt & Whitney
Sheldon Machine Co., Inc.
Sidney Machine Tool Co.
Simmons Machine Tool Corp.
Sundstrand Machine Tool Co.
Van Norman Co.

MILLING MACHINES, Lincoln Type
Brown & Sharpe Mfg. Co.
Sundstrand Machine Tool Co.

MILLING MACHINES, Planer Type
Cincinnati Planer Co.
Consolidated Mch. Tool Corp.
Gray, G. A., Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Pratt & Whitney

MILLING MACHINES, Profile
Cincinnati Milling Machine Co.
Gorton, George, Machine Co.
Pratt & Whitney
Sundstrand Machine Tool Co.

MILLING MACHINES, Ram Type, Universal
Van Norman Co.

MILLING MACHINES, Turret Type
Bridgeport Machines, Inc.

MILLING MACHINES, Vertical
Brown & Sharpe Mfg. Co.
Cincinnati Milling Machine Co.
Consolidated Mch. Tool Corp.
DoAll Co.
Gorton, George, Machine Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Linley Brothers Co.
Pratt & Whitney
Sidney Machine Tool Co.
Sundstrand Machine Tool Co.
Taylor & Fenn Co.

MODEL AND EXPERIMENTAL WORK
See Special Machinery Tools.

MOLD AND DIE COPYING MACHINES
Gorton, George, Machine Co.
Pratt & Whitney

MOLDING MACHINES, Plastic
Elmes Engineering Div., American Steel Foundries
Giddings & Lewis Machine Tool Co.
Hannifin Corp.
Rockford Machine Tool Co.

MOLYBDENUM
Climax Molybdenum Co.

MOTORS, Electric
Delco Products Div., General Motors Corp.
General Electric Co.
Reliance Elec. & Engrg. Co.
U. S. Electrical Motors, Inc.
Westinghouse Electric Corp.

MOTORS, Hydraulic
Oilgear Co.
Sundstrand Machine Tool Co.

MOUNTINGS, RUBBER, JOINTS AND COUPLINGS
Raybestos-Manhattan, Inc., Manhattan Rubber Div.

TWO MODELS
The new heavy duty ACE Cutter Grinder for high speed and tungsten carbide metals (illustrated).
The standard Oliver ACE Cutter Grinder for light duty.

PRESTIGE

Webster says "prestige" means the power to command respect and admiration. The prestige enjoyed by Oliver comes from actual users of Oliver machines over the years.

The Oliver ACE Cutter Grinder illustrated above has for years expedited production and reduced costs in toolrooms all over the world.

The ACE Cutter Grinder is an accurate, economical, universal machine which operates on a new principle. The work is held stationary and the grinding wheel traverses the cutting edge.

The ACE will do a better job with less fixtures, less operator's fatigue, because the work is always in plain sight. Simple to set up, easy to operate, requires less floor space, and yet this machine is priced below the ordinary cutter grinder.

Write today for full information on the ACE Cutter Grinder—it will save you dollars.

OLIVER INSTRUMENT CO.
1410 E. MAUMEE • ADRIAN, MICHIGAN

AUTOMATIC DRILL GRINDERS
TOOL & CUTTER GRINDERS—DRILL POINT THINNERS—TEMPLATE TOOL GRINDERS—FACE MILL GRINDERS—DIEMAKING MACHINES

For more information on products advertised, use Inquiry Card, Page 225

MULTIPLE-SLIDE FORMING MACHINES
Baird Machine Co.
U. S. Tool Co., Inc.

NIBBLING MACHINES
Campbell Machine Div., American Chain & Cable
Gray Machine Co.

NIBBLING MACHINES, Nickel
International Nickel Co.

NIPPLE THREADING MACHINERY
Landis Mch. Co.
Murchey Div., Sheffield Corp.

NUT MAKING MACHINERY
National Machinery Co.

NUT SETTING EQUIPMENT
See Screw Driving and Nut Setting Equipment.

NUT TAPPERS
See Bolt & Nut Machinery.

NUTS, Cold Forged, Wing and Cap
Parker-Kalon Corp.
Republic Steel Corp., Union Drawn Steel Div.

NUTS, Thumb or Wing and Cap
Republic Steel Corp., Bolt & Nut Div.
Williams, J. H., & Co.

OIL EXTRACTORS AND CLEANERS
De Laval Separator Co.
Barnes Drill Co. (Magnetic)

OIL GROOVERS
Fischer Machine Co.
Hanson-Whitney Co.
Wicaco Machine Co.

OIL SEALS
Crane Packing Co.
Garlock Packing Co.

OILERS AND LUBRICATORS
Madison-Kipp Corp.
Manzel, Inc.

OILS, Cutting
See Cutting and Grinding Fluids.

OILS, Lubricating
Cities Service Oil Co.
Gulf Oil Corp.
Shell Oil Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
Stuart, D. A., Oil Co., Ltd.
Sun Oil Co.
Texas Co.
Tide Water Associated Oil Co.

OILS, Quenching and Tempering
Cities Service Oil Co.
Gulf Oil Corp.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
Stuart, D. A., Oil Co., Ltd.

OILS, Soluble
See Compounds, Cutting, Grinding, Metal Drawing, Etc.

ORDNANCE MACHINES, Special
Rehnberg-Jacobson Mfg. Co.

PACKING, Leather, Metal, Rubber, Asbestos, Etc.
Garlock Packing Co.
Raybestos-Manhattan, Inc., Manhattan Rubber Div.

PARALLELS
Brown & Sharpe Mfg. Co.
Rahn Granite Surface Plate Co.
Starrett, The L. S., Co.
Taft-Peirce Mfg. Co.
Walker, O. S., Co., Inc.

PATTERNS, Wood and Metal
Mummert-Dixon Co.

PHOSPHOR BRONZE—See Bronze.

PILLOW BLOCKS
Boston Gear Works, Inc.
Norma-Hoffmann Bearings Corp.
S K F Industries, Inc.
Standard Pressed Steel Co.

PIPE, BRASS AND COPPER
American Brass Co.
Bridgeport Brass Co.
Revere Copper & Brass Inc.

PIPE STEEL
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Jones & Laughlin Steel Corp.
Republic Steel Corp.
Ryerson, Joseph T., & Son, Inc.
U. S. Steel Corp., National Tube Co., Div.

PIPE THREADING AND CUTTING MACHINES
Landis Mch. Co.
Murchey Div., Sheffield Corp.

PIPE TONGS
Armstrong Bros. Tool Co.
Williams, J. H., & Co.

PLANER ATTACHMENTS
Cincinnati Planer Co.
Consolidated Mch. Tool Corp.
Gray, G. A., Co.
Hanson-Whitney Co.
Rockford Machine Tool Co.

PLANERS
Baldwin Locomotive Works
Cincinnati Planer Co.
Cleveland Punch & Shear Works Co. (Plate)
Consolidated Mch. Tool Corp. (Incl. Plate, Rotary and Crank Types)
Gray, G. A., Co.
Rockford Machine Tool Co.

PLANERS, Openside
Cincinnati Planer Co.
Gray, G. A., Co.
Rockford Machine Tool Co.

PLASTIC AND PLASTIC PRODUCTS
Bakelite Div., Union Carbide & Carbon Corp.

PLATE ROLLS
Baldwin Locomotive Works
Bethlehem Steel Co.
Cleveland Punch & Shear Wks. Co.
Consolidated Mch. Tool Corp.
Ryerson, Joseph T., & Son, Inc.

PLATES, Angle
Rahn Granite Surface Plate Co.

PLATES, Surface
Brown & Sharpe Mfg. Co.
Challenge Machinery Co.
Pratt & Whitney
Rahn Granite Surface Plate Co.
Rotor Tool Co.
Scherr, George, Co., Inc.
Taft-Peirce Mfg. Co.
U. S. Tool Company, Inc.

PNEUMATIC EQUIPMENT
Bliss, E. W., Co.
Chicago Pneumatic Tool Co.
Hannifin Corp.
Logansport Machine Co., Inc.

POLISHING LATHES and Machines
Gardner Machine Co.
Hill Acme Co.
Sundstrand Machine Tool Co.

POLISHING TOOLS, Portable
Jarvis, Charles L., Co.
Sundstrand Machine Tool Co.
Van Dorn Electric Tool Co.

PRESSES, Arbor
Baldwin Locomotive Works
Dake Engine Co.
du Mont Corp.
Farquhar, A. B., Co.
Hannifin Corp.
Logansport Machine Co., Inc.
Tompkins-Johnson Co.
Wilson, K. R.

PRESSES, Broaching
American Broach & Mch. Co.
Bliss, E. W., Co.
Farquhar, A. B., Co.
Lake Erie Engineering Corp.
Lapointe Machine Tool Co.
Oilgear Co.

PRESSES, Extrusion
Chambersburg Engineering Co.
Elmes Engineering Div., American Steel Foundries
Farquhar, A. B., Co.
Hydropress, Inc.

PRESSES, Foot
Baird Machine Co.
Bliss, E. W., Co.
Niagara Machine & Tool Wks.
Taylor & Fenn Co.
V & O Press Co., Div. Rockwell Mfg. Co.

PRESSES, Forging
Ajax Manufacturing Co.
Baldwin Locomotive Works
Bethlehem Steel Co.
Bliss, E. W., Co.
Clearing Mch. Co.
Cleveland Punch & Shear Wks. Co.
Elmes Engineering Div., American Steel Foundries
Farquhar, A. B., Co.
Henry & Wright Div. of Hartford-Empire Co.
Hydropress, Inc.
Lake Erie Engineering Corp.
Morgan Engineering Co.
National Machinery Co.
Niagara Machine & Tool Wks.
Verson Allsteel Press Co.
V & O Press Co., Div. Rockwell Mfg. Co.
Zeh & Hahnemann Co.

PRESSES, Hydraulic
American Broach & Mch. Co.
Anderson Bros. Mfg. Co.
Baldwin Locomotive Works
Bethlehem Steel Co.
Birdsboro Steel Fdry. & Mch. Co.

Bliss, E. W., Co.
Chambersburg Engineering Co.
Clearing Mch. Co.
Colonial Broach Co.
Dake Engine Co.
Denison Engineering Co.
Elmes Engineering Div., American Steel Foundries
Farquhar, A. B., Co.
Farrel-Birmingham Co., Inc.
Hannifin Corp.
Hydropress, Inc.
Lake Erie Engineering Corp.
Lima-Hamilton Corp.
Lapointe Machine Tool Co.
Morgan Engineering Co.
National Erie Corp.
Niagara Machine & Tool Wks.
Oilgear Co.
Verson Allsteel Press Co.
Wilson, K. R.

PRESSES, Screw

Bliss, E. W., Co.
Niagara Machine & Tool Wks.
Zeh & Hahnemann Co.

PRESSES, Sheet Metal Working

Baldwin Locomotive Works
Bliss, E. W., Co.
Cincinnati Shaper Co.
Clearing Mch. Co.
Cleveland Crane & Engrg. Co.
Cleveland Punch & Shear Wks. Co.
Consolidated Mch. Tool Corp.
Danly Machine Specialties Co.
Elmes Engineering Div., American Steel Foundries
Farquhar, A. B., Co.
Henry & Wright Div. of Hartford-Empire Co.
Hydropress, Inc.
Lake Erie Engineering Corp.
L & J Press Corp.
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Sales Service Mch. Tool Co.
Verson Allsteel Press Co.
V & O Press Co., Div. Rockwell Mfg. Co.
Zeh & Hahnemann Co.

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Colonial Broach Co.
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Elmes Engineering Div., American Steel Foundries
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Hannifin Corp.
Hydropress, Inc.
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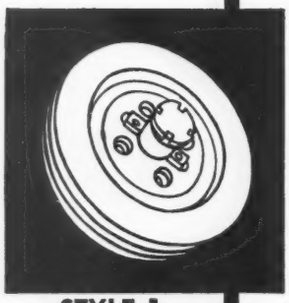
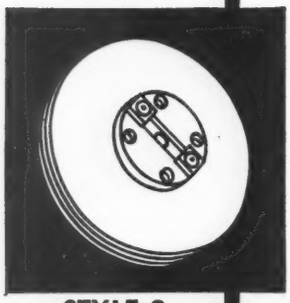


STYLE 1



STYLE 2

STYLE 3

IMPROVE *milling cutter performance*

INCREASE *cutting blade life!*

You can increase milling production, improve accuracy and lengthen blade life by using Lovejoy Flywheels. Steel cutting is as smooth as silk, and other metals are usually cut easier and faster with the help of these patented Flywheels. One manufacturer reports a 10-time increase in blade life. Others report complete elimination of chatter with resulting improvement of surface finish. Still others have proof of reduced H. P. requirements.

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Denison Engineering Co.
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Oilgear Co.
Sundstrand Machine Tool Co.
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Vickers, Inc.
Viking Pump Co.

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Chicago Pneumatic Tool Co.

PUMPS, Rotary
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Sundstrand Machine Tool Co.
Tuthill Pump Co.
Vickers, Inc.
Viking Pump Co.

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See Dies, Sheet Metal, Etc.

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Cincinnati Shaper Co.
Cleveland Punch & Shear Works Co.
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Wiedemann Machine Co.

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Barber-Colman Co.
Butterfield Div., Union Twist Drill Co.
Carboloy Co., Inc.
Cleveland Twist Drill Co.
Ex-Cell-O Corporation

For more information on products advertised, use Inquiry Card, Page 225

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Keo Cutters
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Pratt & Whitney
Standard Tool Co.
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National Twist Drill & Tool Co.
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RECORDING INSTRUMENTS for Temperature
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U. S. Tool Company, Inc.

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Norton Co.

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Bristol Co.
General Electric Co.
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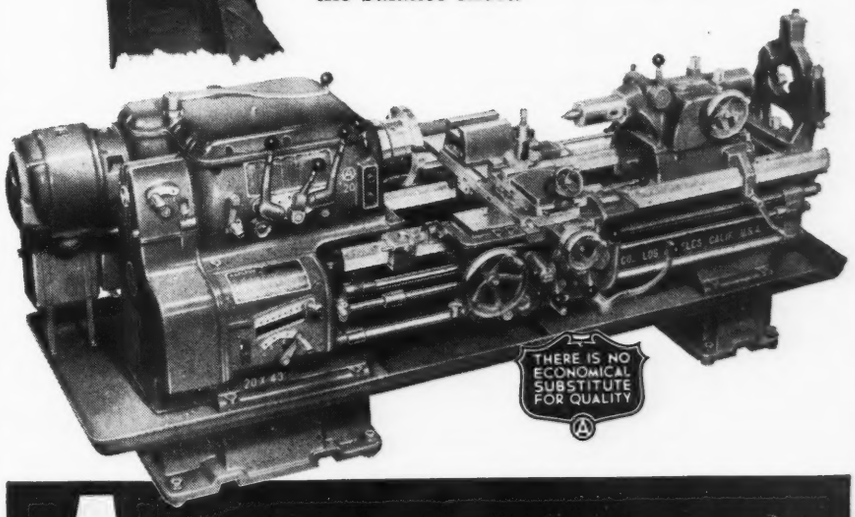

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RIVETERS, Pneumatic
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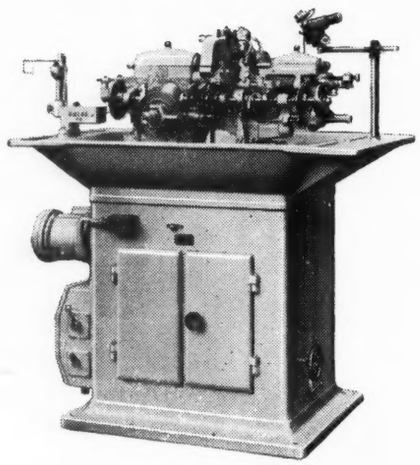

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Warner & Swasey Co.

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Morse Twist Drill & Machine Co.
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New Britain Machine Co., New Britain-Gridley Mch. Div.
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National Acme Co.
Ottemiller, W. H., Co.
Parker-Kalon Corp.
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Parker-Kalon Corp.

SCREWS, Thumb
American Screw Co.
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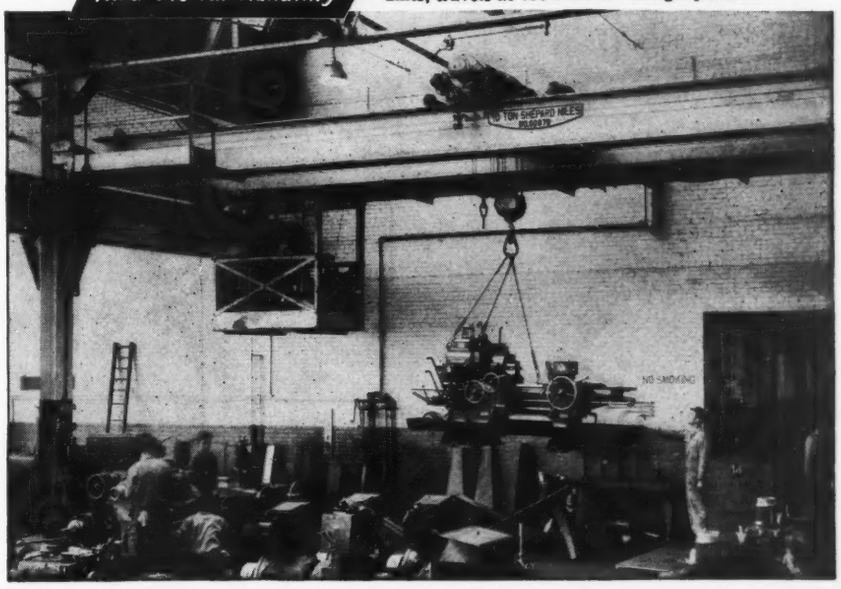
(Continued on page 337)

For Lowest Cost Per Load- Use Dependable Thru-the-Air Handling

For this installation, operating conditions called for rapid travel over a large area. Controlled by operator in the cab, this Shepard Niles 10-ton, welded-beam crane, with main and auxiliary hoist units, travels at 450 F.P.M.—bridge speed.



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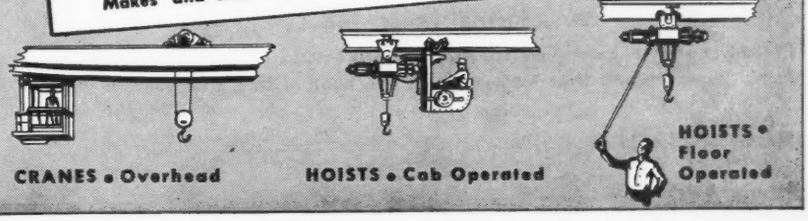

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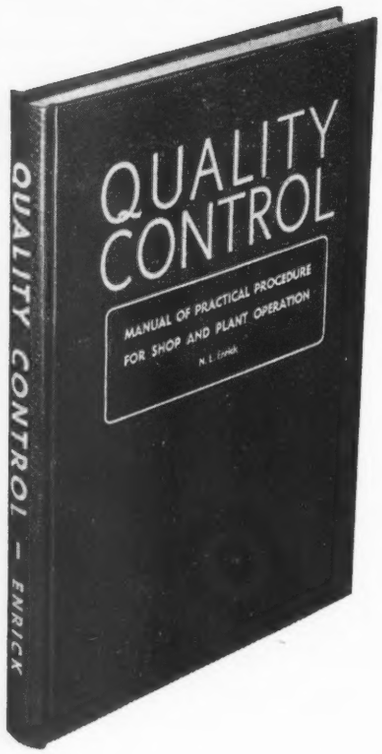

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SHAFTS, Hollow Bored
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Bliss, E. W., Co.
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Elmes Engineering Div., American Steel Foundries
Ex-Cell-O Corp.
Farrel-Birmingham Co., Inc.
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Fischer Machine Co.
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Gisholt Mch. Co.
Gorton, George, Machine Co.
Grant Mfg. & Mch. Co.
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National Automatic Tool Co.
National Broach & Mch. Co.
National-Erie Corp.
National Tool Co.
National Twist Drill & Tool Co.
New Britain Machine Co.,
New Britain-Gridley Mch. Div.
New Jersey Gear & Mfg. Co.
Niagara Mch. & Tool Wks.
Oilgear Co.
Pratt & Whitney
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Sundstrand Mch. Tool Co.
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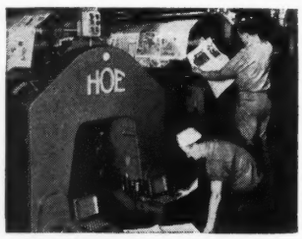
The Allen Pressur-Forming Method is now used to produce nearly all standard Allen screws. Instead of weakening the metal by cutting the steel fibres, it *compresses* them for *extra* toughness.

IF YOU BUY FOR REPLACEMENT . . .

you'll buy less often if you are sure to get the extra strength Allen builds into precision fastenings.

IF YOU ARE DESIGNING OR IMPROVING A PRODUCT . . .

Allen technical development (available through Allen distributors or direct from the factory) leads the field. We work constantly with engineers of leading manufacturers toward the solution of problems involving fastenings and we invite your inquiry.



ASK HOE . . . There's no room for failure in the giant high speed presses that turn out America's newspapers — but there's room for thousands of space-saving Allen ○ Head screws in every Hoe press. This leading manufacturer standardizes on Allen○Head screws for dependability.

SOLD ONLY THROUGH LEADING DISTRIBUTORS

Write the factory direct for technical information and descriptive literature.

WARNING
Allen-Type screws aren't necessarily Allen-Made.
Get genuine "Pressur-Formed" Allen○Head screws in this black and silver box.

ALLEN ALLEN HEAD
MANUFACTURING COMPANY
Hartford 2, Connecticut, U. S. A.
NEW YORK, CLEVELAND, DETROIT, CHICAGO, LOS ANGELES

SPROCKETS
- Atlantic Gear Works, Inc.
- Boston Gear Works, Inc.
- Hartford Special Mchry. Co.
- National-Erie Corp.
- Ohio Gear Co.
- Philadelphia Gear Works
- Stahl Gear & Mch. Co.

STAMPINGS, Sheet Metal
- Aluminum Co. of America
- Dayton Rogers Manufacturing Co.
- Republic Steel Corp., Niles Steel Products Div.
- Revere Copper & Brass Inc.
- Laminated Shim Co., Inc.

STEEL
- Allegheny Ludlum Steel Corp.
- Bethlehem Steel Co.
- Carpenter Steel Co.
- Crucible Steel Co. of America
- Frasse, Peter A., & Co., Inc.
- Ingersoll Steel Div., Borg-Warner Corp.
- Jones & Laughlin Steel Corp.
- Republic Steel Corp.
- Ryerson, Joseph T., & Son, Inc.
- Timken Roller Bearing Co.
- U. S. Steel Corp. (American Steel & Wire Co. Div., Carnegie-Illinois Steel Corp., Div., Columbia Steel Co. Div., Tennessee Coal, Iron & R. R. Co. Div.)
- Vanadium-Alloys Steel Co.
- Wheelock, Lovejoy & Co., Inc.

STEEL, Cold Drawn
- Allegheny Ludlum Steel Corp.
- Bethlehem Steel Co.
- Crucible Steel Co. of America
- Jones & Laughlin Steel Corp.
- Republic Steel Corp., Union Drawn Steel Div.
- Ryerson, Joseph T., & Son, Inc.
- Timken Roller Bearing Co.
- U. S. Steel Corp., American Steel & Wire Co. Div.
- Vanadium-Alloys Steel Co.
- Wheelock, Lovejoy & Co., Inc.

STEEL, High Speed Tool
- Allegheny Ludlum Steel Corp.
- Armstrong Bros. Tool Co.
- Bethlehem Steel Co.
- Carpenter Steel Co.
- Crucible Steel Co. of America
- Republic Steel Corp.
- Ryerson, Joseph T., & Son, Inc.
- Vanadium-Alloys Steel Co.
- Wheelock, Lovejoy & Co., Inc.

STEEL, Machine
- Bethlehem Steel Co.
- Crucible Steel Co. of America
- Jones & Laughlin Steel Corp.
- Republic Steel Corp.
- Ryerson, Joseph T., & Son, Inc.
- Timken Roller Bearing Co.
- Vanadium-Alloys Steel Co.
- Wheelock, Lovejoy & Co., Inc.

STEEL, Stainless
- Allegheny Ludlum Steel Corp.
- Bethlehem Steel Co.
- Carpenter Steel Co.
- Crucible Steel Co. of America
- Frasse, Peter A., & Co., Inc.
- Ingersoll Steel Div., Borg-Warner Corp.
- Republic Steel Corp.
- Ryerson, Joseph T., & Son, Inc.
- Timken Roller Bearing Co.
- U. S. Steel Corp. (American Steel & Wire Co. Div., Carnegie-Illinois Steel Corp. Div.)
- Wheelock, Lovejoy & Co., Inc.

For more information on products advertised, use Inquiry Card, Page 225

STEEL, Strip and Sheet
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Frasse, Peter A., & Co., Inc.
Jones & Laughlin Steel Corp.
Republic Steel Corp.
Ryerson, Joseph T., & Son, Inc.
U. S. Steel Corp. (American Steel & Wire Co. Div., Carnegie-Illinois Steel Corp., Div., Columbia Steel Co. Div., Tennessee Coal, Iron & R. R. Co. Div.)

STEEL, Tool and Die
Allegheny Ludlum Steel Corp.
Carpenter Steel Co.
Republic Steel Corp.
Vanadium-Alloys Steel Co.

STEEL, Zinc, Tin and Copper Coated Strip
Allegheny Ludlum Steel Corp.

STEEL ALLOYS
See Alloys, Steel.

STEEL BARS—See Bars, Steel.

STEEL STOCK GROUND FLAT
Brown & Sharpe Mfg. Co.
Starrett, The L. S., Co.

STOCKS, Die
Armstrong Bros. Tool Co.
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
Pratt & Whitney
Standard Tool Co.
Threadwell Tap & Die Co.

STONES, Oil or Sharpening
Carborundum Co.
Norton Co.

STOOLS
Standard Pressed Steel Co.

STRAIGHT EDGES
Brown & Sharpe Mfg. Co.
Rahn Granite Surface Plate Co.
Starrett, The L. S., Co.

STRAIGHTENERS, Flat Stock and Wire
U. S. Tool Co., Inc.

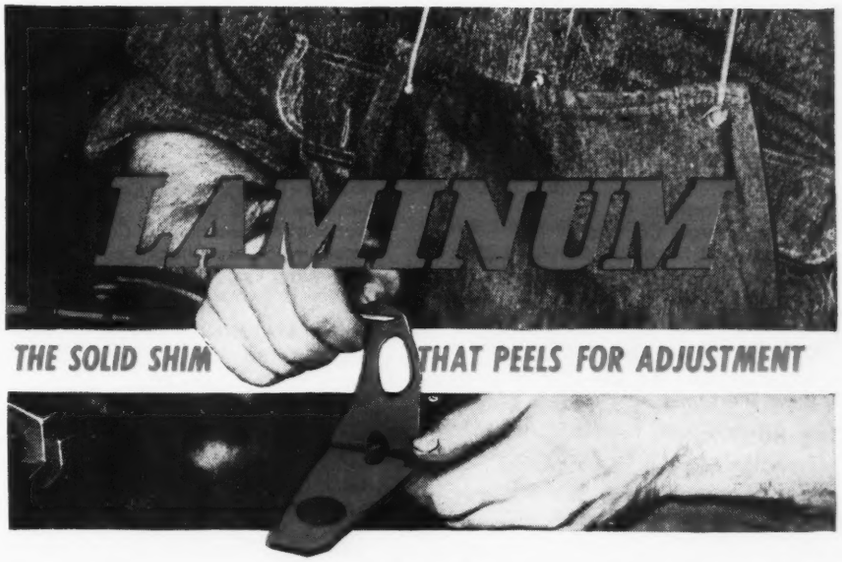
STRAIGHTENING MACHINERY
Baldwin Locomotive Works
Chambersburg Engineering Co.
Consolidated Mch. Tool Corp.
Elmes Engineering Div., American Steel Foundries
Hannifin Corp.
Hydropress, Inc.
Lake Erie Engineering Corp.
Morse Twist Drill & Mch. Co.
Oilgear Co.
Springfield Mch. Tool Co.

STUD SETTERS
Errington Mechanical Laboratory
Procunier Safety Chuck Co.

SUB-PRESSES
Baumbach, E. A., Mfg. Co.
Waltham Machine Works

SUPERFINISHING MACHINES
Gisholt Mch. Co.

Check this over with your Design Engineers!



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- **Greater machining tolerances—less expense**
- **No wasteful standby lathe required**
- **Plus economies in original design**

AND

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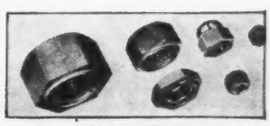
3908 UNION STREET GLENBROOK, CONN.

CUSTOM SHIMS

STAMPINGS

SHIM STOCK


AN·COR·LOX NUTS

SURFACE FINISH STANDARDS
Blake, Edward, Co.

SURFACE PLATES
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SWAGING MACHINES
Cincinnati Shaper Co.
Hartford Special Machinery Co.
Torrington Co.

SWITCHES
Allen-Bradley Co.
General Electric Co.
National Acme Co.
Shepard Niles Crane & Hoist Corp.
Westinghouse Electric Corp.

TACHOMETERS
Bristol Co.
Leeds & Northrup Co.
Scherr, George, Co., Inc.
Veeder-Root Inc.

TAPE
Topflight Tape Co.

TAPER PINS, Standard
Morse Twist Drill & Mch. Co.
Pratt & Whitney

TAP HOLDERS
Errington Mechanical Laboratory
Gairing Tool Co.

TAPPING ATTACHMENTS AND DEVICES
Baker Brothers, Inc.
Brown & Sharpe Mfg. Co.
Errington Mechanical Laboratory
Ettco Tool Co.
Jarvis, Charles L., Co.
Leland Gifford Co.
Procunier Safety Chuck Co.
Snow Mfg. Co.

TAPPING MACHINES
Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F. & John, Co.
Bodine Corp.
Buffalo Forge Co.
Challenge Machinery Co.
Cleveland Tapping Mch. Co.
Cross Co.
Greenlee Bros. & Co.
Hartford Special Machinery Co.
Hill Acme Co.
Jarvis, Charles L., Co.
Kingsbury Mch. Tool Corp.
Leland-Gifford Co.
Moline Tool Co.
Murchey Div., Sheffield Corp.
National Acme Co.
National Automatic Tool Co.
Procunier Safety Chuck Co.
Snow Mfg. Co.
Warner & Swasey Co.

TAPPING MACHINES, Nut
Hill Acme Co.
National Machinery Co.
Snow Mfg. Co.

TAPS
Bath, John, Co., Inc.
Besly, Chas. H., & Co.
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Continental Tool Works Div.
Geometric Tool Co.
Greenfield Tap & Die Corp.
Hanson-Whitney Co.
Landis Machine Co. (Solid Adjustable)
Morse Twist Drill & Machine Co.
Murchey Div.. Sheffield Corp.
Pratt & Whitney
Standard Tool Co.
Sheffield Corp.
Threadwell Tap & Die Co.
Winter Bros. Co.
Wood & Spencer Co.

TAPS, Collapsing
Geometric Tool Co.
Landis Mch. Co.
Murchey Div., Sheffield Corp.
National Acme Co.
Sheffield Corp.

TELESCOPES, Alignment
Engis Equipment Co.

THERMOMETERS, Indicating and Recording
Bristol Co.
Leeds & Northrup Co.

THREAD CUTTING MACHINERY
Brown & Sharpe Mfg. Co.
Cleveland Tapping Mch. Co.
Davis & Thompson Co.
Eastern Machine Screw Corp.
Fellows Gear Shaper Co.
Grant Mfg. & Mch. Co.
Hill Acme Co.
Landis Mch. Co.
Murchey Div., Sheffield Corp.
Pratt & Whitney
Rogers Machine Works, Inc.
Snow Mfg. Co.
Taft-Peirce Mfg. Co.
Warner & Swasey Co.

THREAD CUTTING TOOLS
Armstrong Bros. Tool Co.
Eastern Machine Screw Corp.
Fellows Gear Shaper Co.
Geometric Tool Co.
Hill Acme Co.
Landis Mch. Co.
Pratt & Whitney
Sheffield Corp.
Taft-Peirce Mfg. Co.
Williams, J. H., & Co.

THREAD GAGES
See Gages, Thread.

THREAD GRINDING MACHINES
See Grinding Machines, Thread.

THREAD MILLING MACHINES
Cross Co.
Hanson-Whitney Co.
Murchey Div., Sheffield Corp.
Pratt & Whitney
Waltham Machine Works

THREAD ROLLING MACHINES
Hartford Special Machinery Co.
Hill Acme Co.
National Machinery Co.
V & O Press Co., Div. Rockwell Mfg. Co.

TIN AND TERNE PLATES
Bethlehem Steel Co.
Jones & Laughlin Steel Corp.
Republic Steel Corp.
U. S. Steel Corp. (Carnegie-Illinois Steel Corp. Div., Columbia Steel Co. Div., Tennessee Coal, Iron & R. R. Co Div.)

TOOL BITS, High Speed Steel
Allegheny Ludlum Steel Corp.
Armstrong Bros. Tool Co.
Carpenter Steel Co.
Crucible Steel Co. of America
Ryerson, Joseph T., & Son, Inc.
Simonds Saw & Steel Co.
Vanadium-Alloys Steel Co.
Wheelock, Lovejoy & Co., Inc.
Williams, J. H., & Co.

di-acro PUNCH

NEW DOUBLE PURPOSE PRESS

Available in two sizes, 6" and 12" throat depth

Now you can punch holes of various shapes as large as 4" diameter in 16 gauge steel—also blank, draw, emboss, form—all with the new DI-ACRO Punch. It is ideal for both experimental and production work.

The precision ground triangular ram of this double purpose press prevents punch head from turning, assuring perfect alignment at all times for accuracy in duplicated parts.

A Turret Stripper of exclusive DI-ACRO design automatically strips material from punches of all shapes. Roller Bearing cam action develops 4-ton pressure with minimum effort. Adjustable gauges assure exact location of holes.

Send for **"DIE-LESS DUPLICATING"** *Catalog*

Gives the full story of the DI-ACRO Punch, and also DI-ACRO Benders, Brakes, Shears, Rod Parters, Notchers, as well as the new DI-ACRO Vari-O-Speed Powershear and Hydra-Power Bender.

DI-ACRO is pronounced "DIE-ACK-RO"

O'NEIL-IRWIN MFG. CO.

332 EIGHTH AVENUE • LAKE CITY, MINN.

For more information on products advertised, use Inquiry Card, Page 225

TOOL BITS, Special Alloy
Allegheny Ludlum Steel Corp.
Cleveland Twist Drill Co.
Kennametal, Inc.

TOOL GRINDERS
See Grinders for Sharpening Turning and Planing Tools.

TOOL HOLDERS
Armstrong Bros. Tool Co.
Blake, Edward, Co.
Gairing Tool Co.
Lovejoy Tool Co., Inc.
Michigan Tool Co.
Millholland, W. K., Machinery Co.
R and L Tools
Warner & Swasey Co.
Williams, J. H., & Co.

TOOLMAKERS' INSTRUMENTS
Ames, B. C., Co.
Brown & Sharpe Mfg. Co.
Scherr, George, Co., Inc.
Starrett, The L. S., Co.

TOOL STEEL
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Carpenter Steel Co.
Crucible Steel Co. of America
Republic Steel Corp.
Rverson, Joseph T., & Son, Inc.
Vanadium-Alloys Steel Co.

TOOLS, Carbide-Tipped
Allegheny Ludlum Steel Corp.
Carboloy Co., Inc.
Cleveland Twist Drill Co.
Ex-Cell-O Corporation
Gairing Tool Co.
Kennametal, Inc.
Metal Carbides Corp.
Morse Twist Drill & Machine Co.
Pratt & Whitney
Union Twist Drill Co.

TOOLS, Lathe, Shaper and Planer
Allegheny Ludlum Steel Corp.
Armstrong Bros. Tool Co.
Gairing Tool Co.
Kennametal, Inc.
Lovejoy Tool Co., Inc.
Warner & Swasey Co.
Williams, J. H., & Co.

TRANSFER MACHINES
Cross Co.
Sundstrand Machine Tool Co.

TRANSFORMERS
General Electric Co.

TRANSMISSION MACHINERY
See Hangers, Shafting, Pulleys, Clutches, Couplings, Belting, Chains, Etc.

TRANSMISSION, Variable Speed
DoAll Co.
Oilgear Co.
Reliance Electric & Engrg. Co.
Sundstrand Machine Tool Co.

TUBE FLANGING MACHINES
Grant Mfg. & Mch. Co.

TUBE FORMING AND WELDING MACHINES
Yoder Co.

TUBE TESTING AND EXPANDING MACHINES
Hydropress, Inc.

TUBING, Aluminum
Aluminum Co. of America

TUBING, Brass and Copper
American Brass Co.
Bridgeport Brass Co.
Revere Copper & Brass Inc.

TUBING, Flexible
American Metal Hose Branch, American Brass Co.
Titeflex, Inc.

TUBING, Steel
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Carpenter Steel Co.
Frasse, Peter A., & Co., Inc. (Seamless)
Jones & Laughlin Steel Corp.
Republic Steel Corp., Steel & Tubes Div.
Ryerson, Joseph T., & Son, Inc.
Timken Roller Bearing Co.
U. S. Steel Corp., National Tube Co., Div.

TUMBLING BARRELS
Baird Machine Co.

TWIST DRILLS
See Drills, Twist.

UNIVERSAL JOINTS
Boston Gear Works, Inc.
Lovejoy Flexible Coupling Co. (Dix)

V-BELTS
Raybestos-Manhattan, Inc., Manhattan Rubber Div.

VALVE CONTROLS
Philadelphia Gear Works (Motorized)

VALVES, Hydraulic
Baldwin Locomotive Works
Barnes, John S., Corp.
Denison Engineering Co.
Elmes Engineering Div., American Steel Foundries
Hannifin Corp.
Hydropress, Inc.
Logansport Machine Co., Inc.
Oilgear Co.
Sundstrand Machine Tool Co.
Vickers, Inc.

VALVES, Pneumatic
Hannifin Corp.

VIBRATION INSULATION
American Felt Co.

VISES, Machine
Armstrong-Blum Mfg. Co.
Armstrong Bros. Tool Co.
Brown & Sharpe Mfg. Co.
Hannifin Corp.
Hendey Mch. Co.
Logansport Machine Co., Inc.

VISES, Pipe
Armstrong Bros. Tool Co.
Williams, J. H., & Co.

VISES, Planer and Shaper
Brown & Sharpe Mfg. Co.
Cincinnati Planer Co.
Cincinnati Shaper Co.
Rockford Machine Tool Co.

VOLTMETERS
Bristol Co.
General Electric Co.

WASHERS, Lock
Eaton Manufacturing Co., Reliance Div.

WASHERS, Spring
Eaton Manufacturing Co., Reliance Div.

WELDING AND CUTTING EQUIPMENT, Oxyacetylene
Air Reduction Sales Co.
Linde Air Products Co., Unit Carbide & Carbon Corp.

WELDING AND CUTTING GASES
Air Reduction Sales Co.
Linde Air Products Co., Unit Carbide & Carbon Corp.

WELDING EQUIPMENT, Electric Arc
Air Reduction Sales Co.
General Electric Co.
Westinghouse Electric Corp.

WELDING EQUIPMENT, Electric, Spot, Butt, Seam, Etc.
DoAll Co.

WELDING POSITIONER
Cullen-Friestedt Co.
du Mont Corp.

WELDMENTS
Woods, A. C., & Co.

WIRE
Bethlehem Steel Co.
Jones & Laughlin Steel Corp.
Republic Steel Corp.
U. S. Steel Corp. (American Steel & Wire Co., Div., Columbia Steel Co. Div., Tennessee Coal, Iron & R. R. Co. Div.)

WIRE FORMING MACHINERY
Baird Machine Co.
U. S. Tool Co., Inc.

WIRE NAIL MACHINERY
Bliss, E. W., Co.
National Machinery Co.
Ryerson, Joseph T., & Son, Inc.

WOODWORKING MACHINERY
Greenlee Bros. & Co.
Sidney Machine Tool Co.
Walker-Turner Div., Kearney & Trecker Corp.

WORM DRIVES
Cleveland Worm & Gear Co.
Ohio Gear Co.
Philadelphia Gear Works

WRENCHES
Armstrong Bros. Tool Co.
Elastic Stop Nut Corp. of America
Standard Tool Co.
Williams, J. H., & Co.

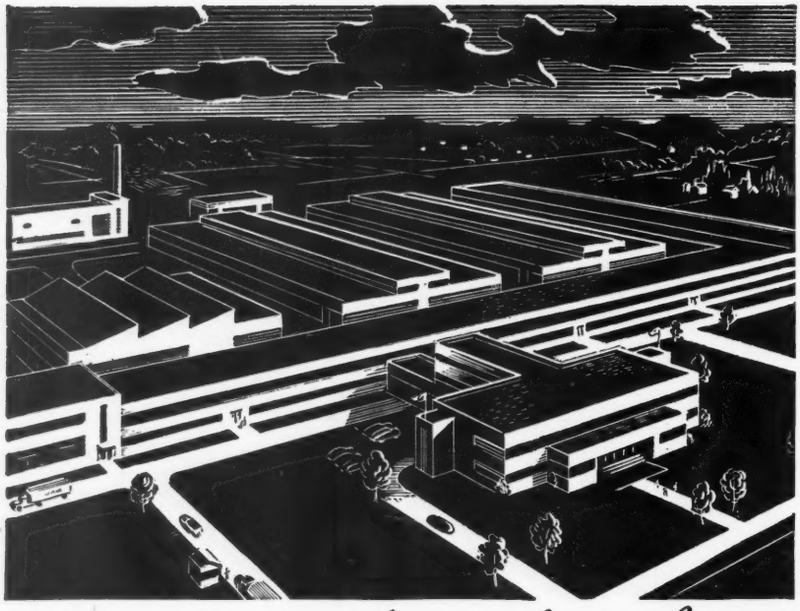
WRENCHES, Detachable Socket
Armstrong Bros. Tool Co.
Williams, J. H., & Co.

WRENCHES, Pipe
Armstrong Bros. Tool Co.

WRENCHES, Ratchet
Armstrong Bros. Tool Co.
Williams, J. H., & Co.

WRENCHES, Tap
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
Pratt & Whitney
Standard Tool Co.

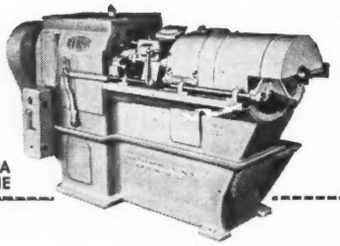
WRENCHES, Torque Measuring
Armstrong Bros. Tool Co.
Williams, J. H., & Co.



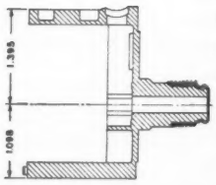
Keenly competitive modern plants have set a single standard for machine tool investments— cost-per-piece— plus sustained machine efficiency.

The reason for insistence on this scientific approach is obvious: the *right* machine pays for itself and begins producing sustained profit in a matter of months, weeks, even days.

New Britain Automatics are designed and built with *sustained low cost-per-piece* as the first consideration.



NEW BRITAIN MODEL 23A AUTOMATIC CHUCKING MACHINE



A New Britain Model 23-A four spindle tool rotating chucking machine turns out the part sketched, which is made from zinc alloy SAE Specification 903. Ten operations are performed, including turning, facing, chamfering, grooving and threading. In turning the outside diameter for threading, concentricity with the previously finished inside diameter is assured by the use of a pilot tool. 742 pieces are completed hourly — one every 4.8 seconds.

NEW BRITAIN

Automatics

THE NEW BRITAIN MACHINE COMPANY
NEW BRITAIN-GRIDLEY MACHINE DIVISION
NEW BRITAIN, CONNECTICUT

650HF1

MULTIPLE SPINDLE AUTOMATIC SCREW AND CHUCKING MACHINES • SINGLE AND DOUBLE END PRECISION STRAIGHT AND CONTOUR BORING MACHINES • LUCAS PRECISION HORIZONTAL BORING, DRILLING AND MILLING MACHINES

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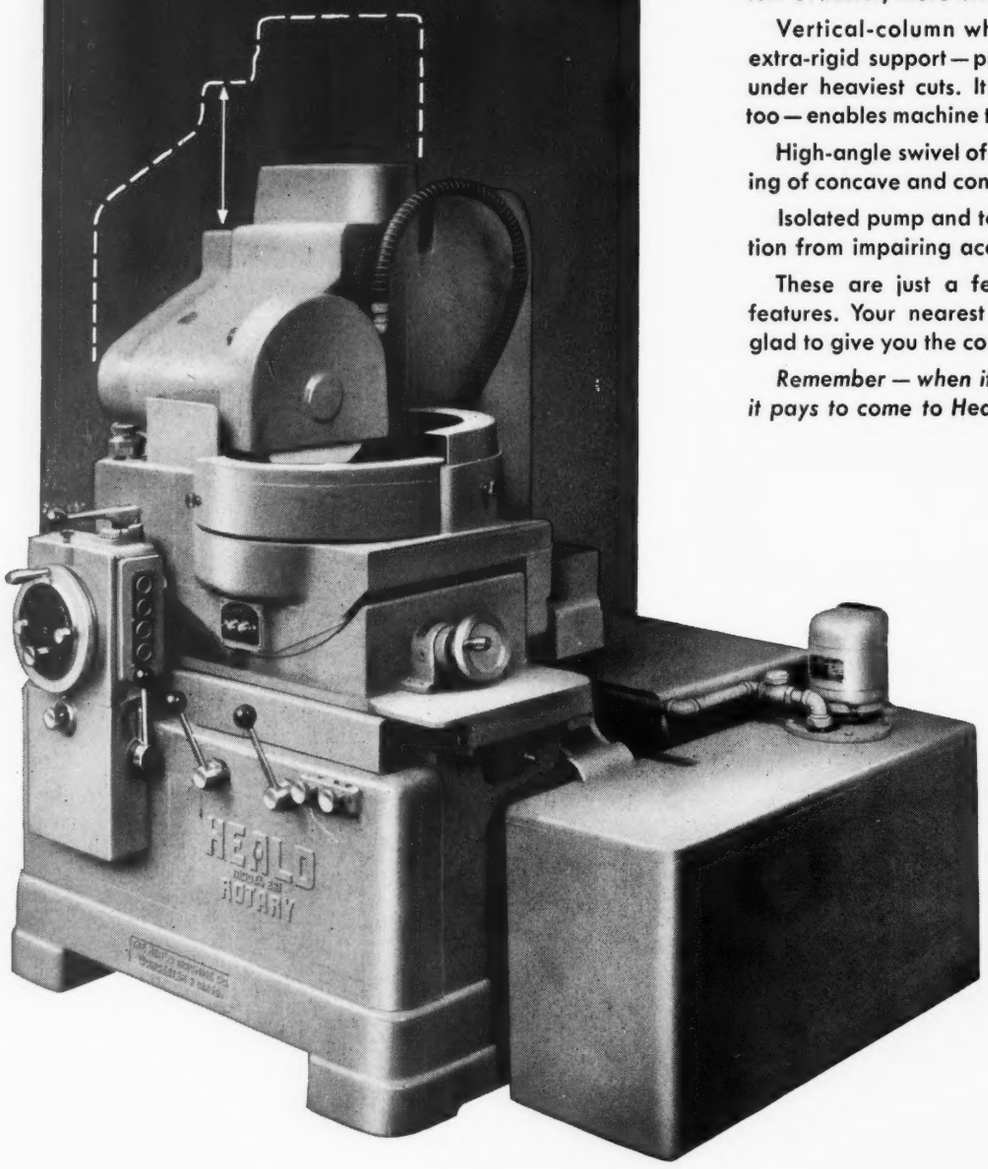

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